Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Maritimes Region

Canadian Science Advisory Secretariat
Science Response 2016/011

2015 MARITIMES RESEARCH VESSEL SURVEY TRENDS ON THE SCOTIAN SHELF AND BAY OF FUNDY

Context

DFO has conducted Summer Research Vessel (RV) surveys in the Maritimes Region, Northwest Atlantic Fisheries Organization (NAFO) Divisions 4VWX and a small portion of 5Y, using a standardized protocol since 1970 (Figure 1). Results of these surveys provide information on trends in abundance for most groundfish species in the Maritimes Region. While these data reflect trends in biomass and abundance and are a critical part of science-based stock assessments, a full assessment, including other sources of data, would be required to evaluate the impacts of management measures on population status. Fisheries and Aquaculture Management (FAM) requested a review of the DFO RV survey information on the following list of fish stocks: 4Vn Atlantic Cod, 4VsW Atlantic Cod, 4X5Y Atlantic Cod, 4VW Haddock, 4X5Y Haddock, 4X White Hake, 4VW White Hake, 4VWX Silver Hake, 4VWX+5 Pollock, Unit II Redfish, Unit III Redfish, 3NOPs4VWX+5 Atlantic Halibut, 4VW and 4X American Plaice, 4VW and 4X Witch Flounder, 4VW and 4X Winter Flounder, 4VW and 4X Yellowtail Founder, 4VW and 4X Smooth Skate, 4VW and 4X Thorny Skate, 4VW and 4X Barndoor Skate, 4VW and 4X Winter Skate, 4VW and 4X Little Skate, 4VW and 4X Atlantic Wolffish, 4VW and 4X Monkfish, 4VW and 4X Longhorn Sculpin, and 4VWX Spiny Dogfish. In addition, biomass trends relative to the Scotia-Fundy Groundfish Advisory Committee (SFGAC) accepted biomass reference points were requested for White Hake (biomass for lengths >41 cm) and Unit III redfish (biomass for lengths >22 cm). The survey information will be used by DFO Resource Management as background for discussions with various industry stakeholders on recommendations for management measures, and to determine which stocks should be reviewed in more detail in 2016.

This Science Response Report results from the Science Response Process of November 30, 2015, on the Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy.

March 2016

Canada

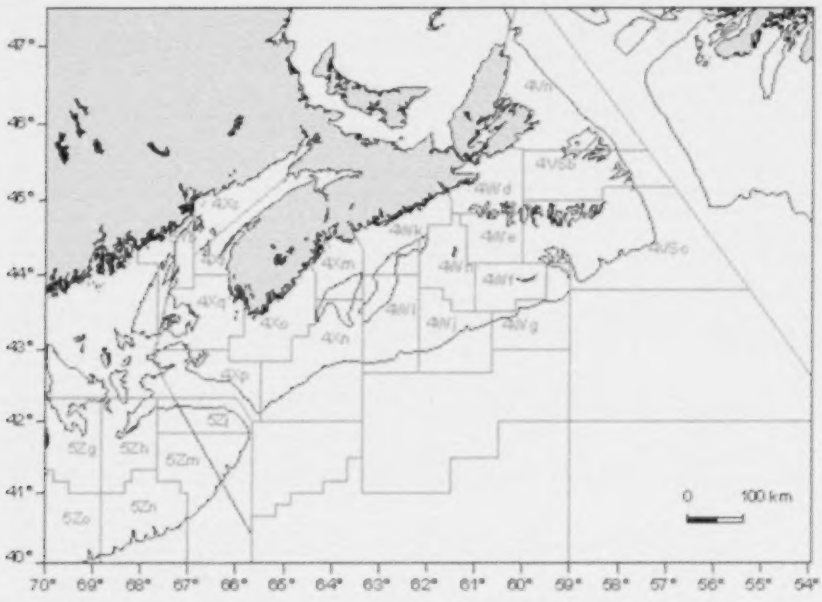

Figure 1. Northwest Atlantic Fisheries Organization (NAFO) Unit Areas.

Background

The DFO Summer Research Vessel (RV) Survey of the Scotian Shelf and Bay of Fundy has been conducted annually since 1970. The surveys follow a stratified random sampling design, and include sampling of fish and invertebrates using a bottom otter trawl. These surveys are the primary data source for monitoring trends in species distribution, abundance, and biological condition within the region. There were changes to the net used and the vessel conducting the survey in 1982 and 1983, along with some changes in data collection protocols. These changes may affect the biomass trends for some species. For long-term averages, the most appropriate starting point has been selected for each species (for details see Clark and Emberley, 2011).

The bottom trawl surveys were designed to provide abundance trends for fish and invertebrates between depths of about 30 m to 400 m. Sampling is generally conducted between late June and early August. There are 244 stations allocated to 57 strata. Strata boundaries are shown in Figure 2 for the 4VWX5 area. In 2015, 223 sets were completed with at least two stations occupied for all strata used in deriving indices of abundance for this report. Survey indices are expected to be proportional to abundance for most species.

Sampling was conducted in all 4VWX strata, and in 5Z9. Due to mechanical problems with the vessel, 18 days were lost in the middle of the survey period. This meant some sampling objectives were dropped and coverage was poor in some strata. The completion date for the set of strata which has been sampled every year since 1970 was August 17. As a result of mechanical problems on the ship, completion of the these strata in 2014 and 2015 was more than a week later than in any other year.

Catch distribution plots for the entire Summer RV Survey area are provided for a suite of species that are commonly caught in the 4VWX groundfish fishery. Biomass index trends are shown for the area appropriate for each stock. Comparisons of 2014 and 2015 length frequencies from the survey catch to the long-term mean (from beginning of survey series, or

the period deemed appropriate for that particular species, to 2013) are also included, using data from the geographic areas that are used in assessments for those stocks.

Figure 2. 2015 Summer Research Vessel Survey strata.

Analysis

The time-series of survey biomass indices are compared to averages for a series of time periods to provide historical context for biomass levels. The time periods used are a short-term 5-year average (2010-2014), a medium-term 15-year average (2000-2014), and the long-term survey average (1970-2014) (Table 1).

Table 1. Research Vessel survey biomass indices (tonnes) for species by stock/region for 2013, 2014, 2015 and averages for long-term (1970-2014), medium-term 15-year (2000-2014), and short-term 5-year (2010-2014) time periods.

Stock/Region	2013	2014	2015	1970-2014 Avg.	2000-2014 Avg.	2010-2014 Avg.
4X Cod	2,058	2,513	3,722	19,739	8,213	2,930
4VsW Cod	9,525	23,393	3,464	50,233	17,470	20,080
4Vn Cod	966	2,388	1,729	14,784	4,410	3,127
4VW Haddock	43,461	33,409	20,094	58,533	60,437	36,902
4X Haddock	36,580	42,883	69,823	55,724	52,551	40,371
4VW White Hake	2,868	3,159	5,768	9,657	4,920	3,663
4X White Hake	7,443	9,644	6,452	18,144	11,366	9,744
4VWX Silver Hake*	35,461	60,364	40,232	36,668	30,935	46,852
Western Component Pollock	26,823	9,752	5,199	29,992	27,716	11,426
Eastern Component Pollock	33,006	13,654	22,191	30,182	27,193	50,603
Unit II Redfish	23,233	55,170	14,675	49,220	39,662	50,709
Unit III Redfish	77,123	76,917	176,417	114,889	126,650	130,834
4X American Plaice	312	525	273	1,982	1,081	696
4VW American Plaice	19,559	3,369	5,669	23,320	14,774	10,493
4X Witch Flounder	869	1,592	1,684	1,797	1,372	1,201
4VW Witch Flounder	4,773	2,323	2,932	3,942	4,254	4,029
4X Yellowtail Flounder	102	119	466	651	765	327
4VW Yellowtail Flounder	14,646	11,485	9,690	13,524	10,123	11,463
4X Winter Flounder	6,448	2,673	6,251	3,557	5,341	6,398
4VW Winter Flounder	426	431	1,366	883	526	549
4VWX Atlantic Flounder	8,656	8,531	10,790	3,631	5,404	7,985
4X Atlantic Wolffish	10	25	208	2,017	569	266
4VW Atlantic Wolffish	176	267	142	1,886	759	307
4X Monkfish	308	1,258	803	2,181	943	604
4VW Monkfish	760	454	638	3,106	1,061	762
4X Smooth Skate	326	344	339	474	350	343
4VW Smooth Skate	49	40	81	449	160	116
4X Thorny Skate	323	372	606	3,794	730	267
4VW Thorny Skate	1,421	705	1,111	10,994	3,627	2,067
4X Barndoor Skate	985	2,879	1,453	511	1,251	1,593
4VW Barndoor Skate	1,169	712	253	273	391	826
4X Winter Skate	998	323	1,134	985	827	1,021
4VW Winter Skate	277	460	139	3,425	686	336
4X Little Skate	1,467	521	1,726	801	997	1,016
4VW Little Skate	262	76	0	136	104	109
4VWX Spiny Dogfish	259,461	133,384	42,473	127,653	161,017	95,989
4X Longhorn Sculpin	803	713	1,568	1,563	1,709	1,131
4VW Longhorn Sculpin	1,637	1,261	2,147	2,798	2,422	1,818

*For Silver Hake, long-term average is 1982-2014.

Atlantic Cod

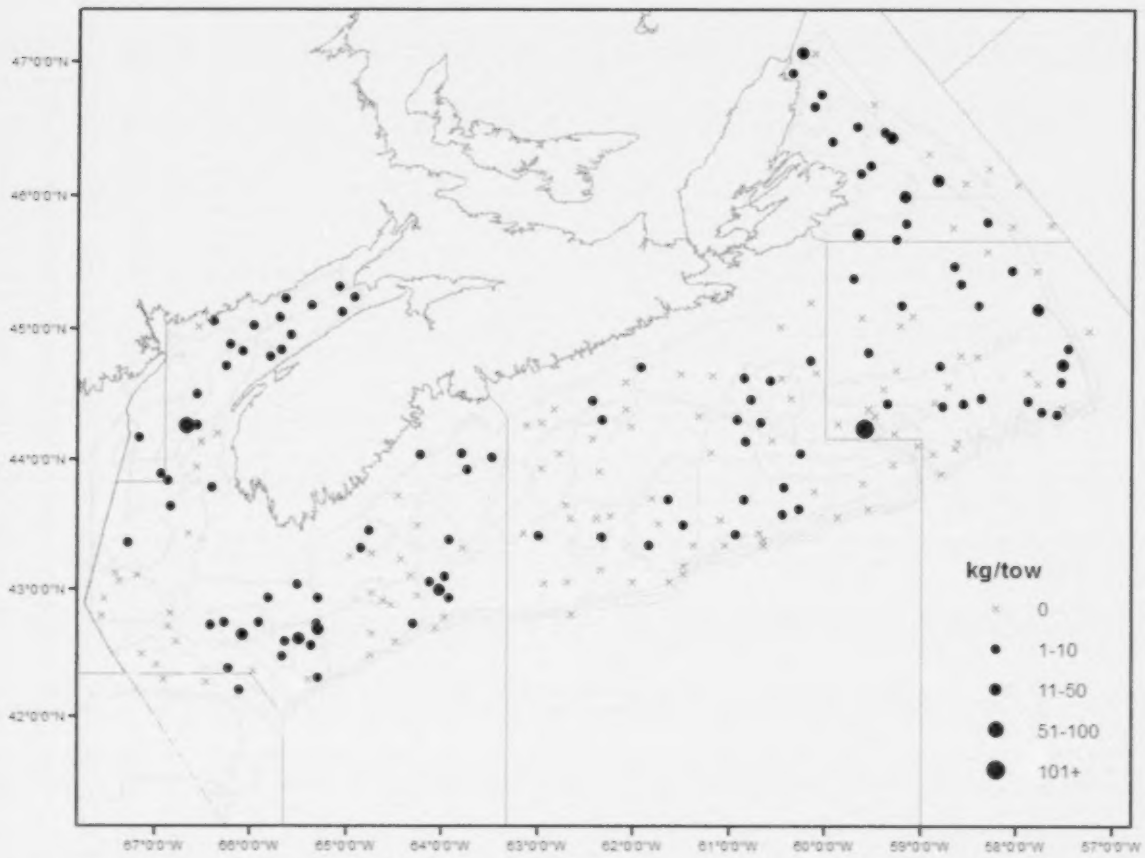

Figure 3a. Distribution of Atlantic Cod catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

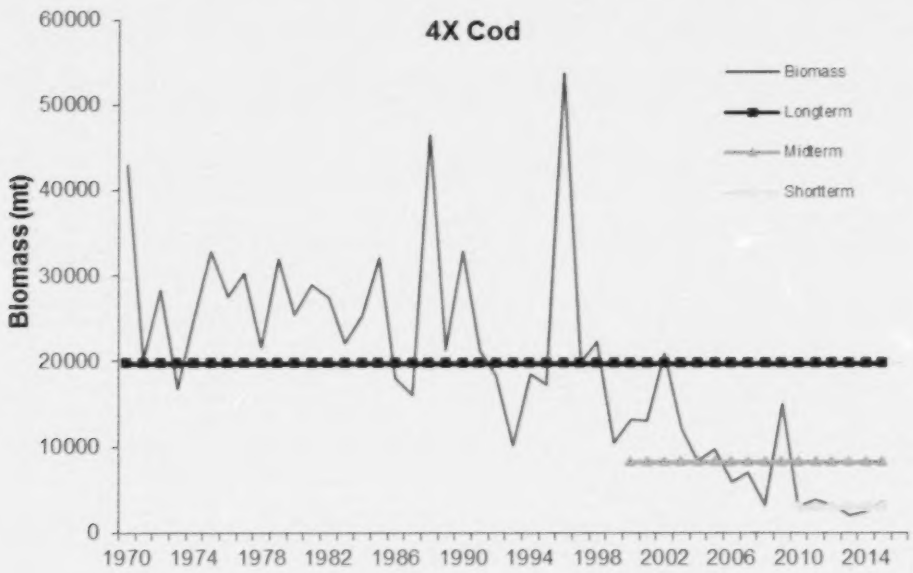

Figure 3b. Biomass index for Atlantic Cod in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

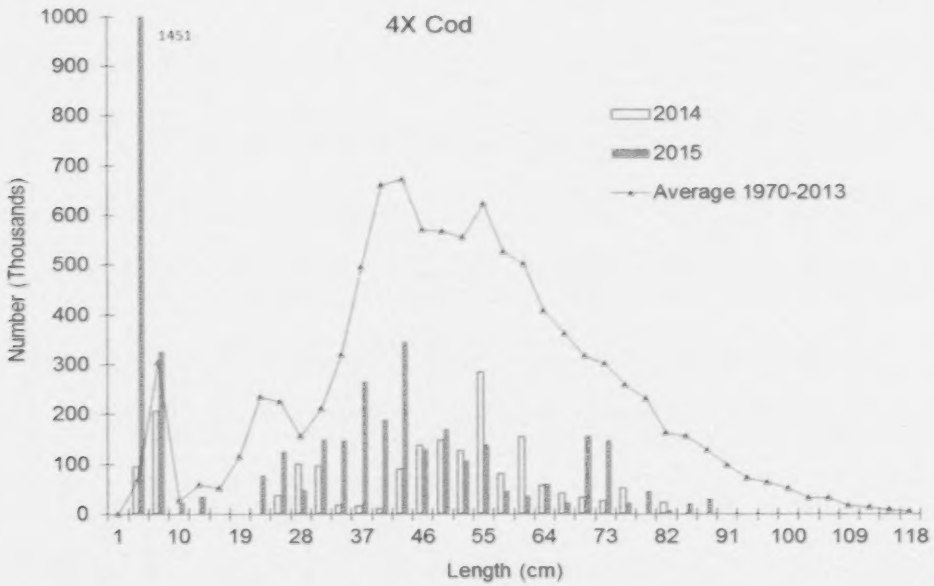

Figure 3c. Length frequency indices for Atlantic Cod in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

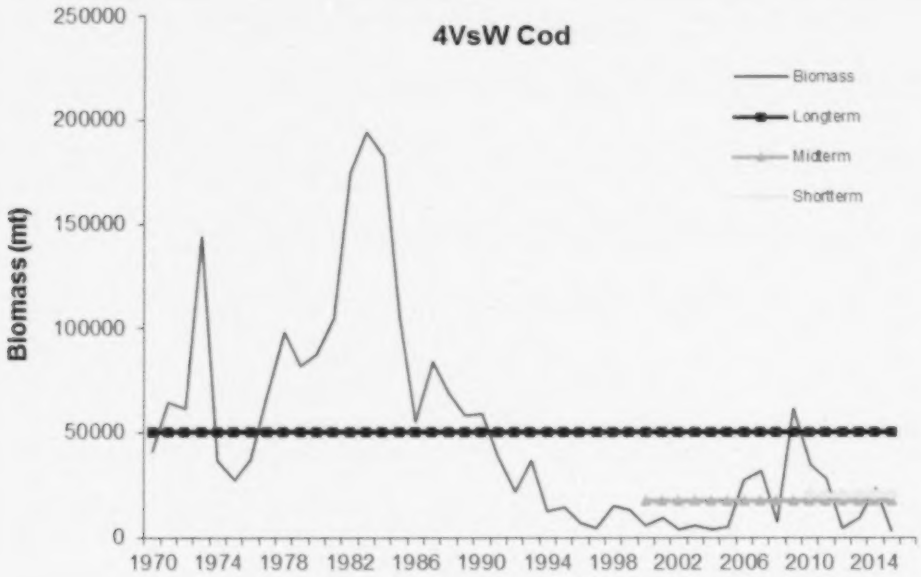

Figure 3d. Biomass index for Atlantic Cod in 4VsW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

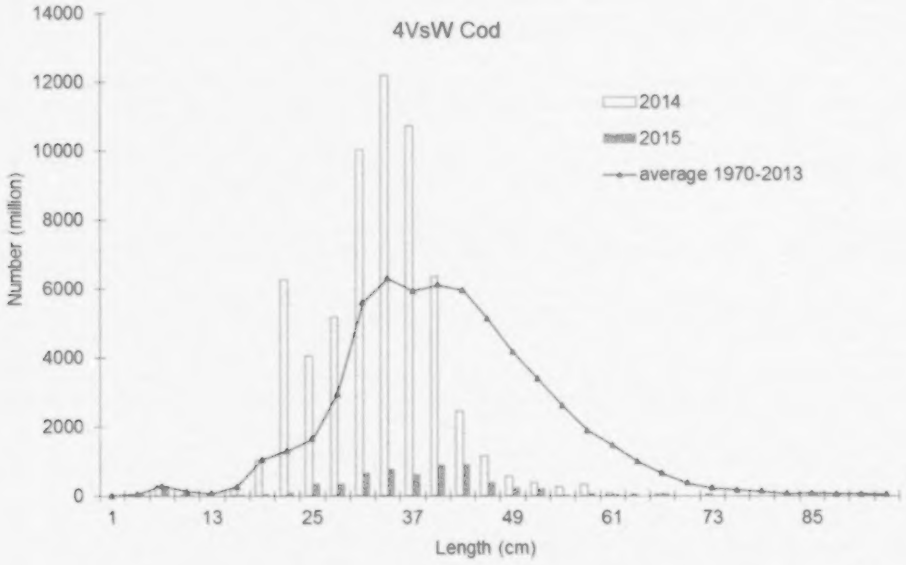

Figure 3e. Length frequency indices for Atlantic Cod in 4VsW from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

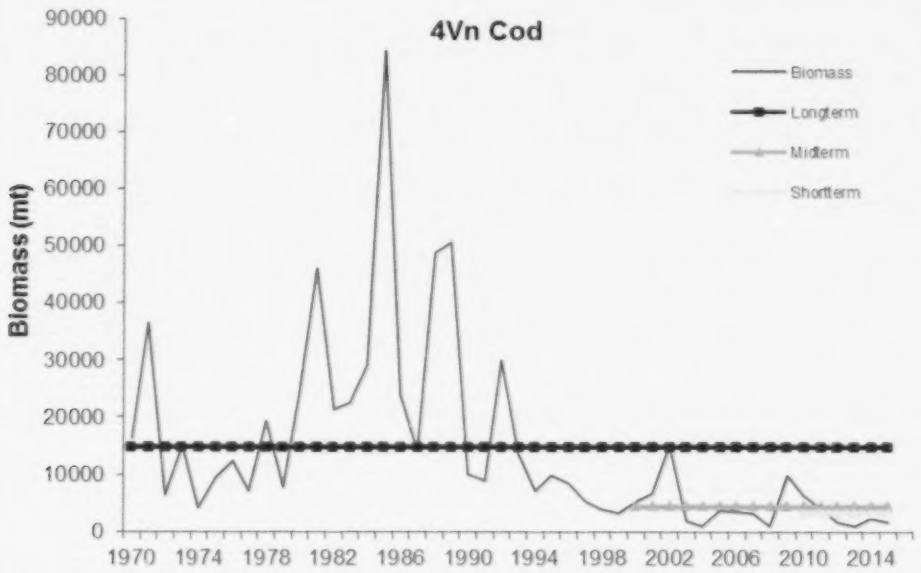

Figure 3f. Biomass index for Atlantic Cod in 4Vn from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

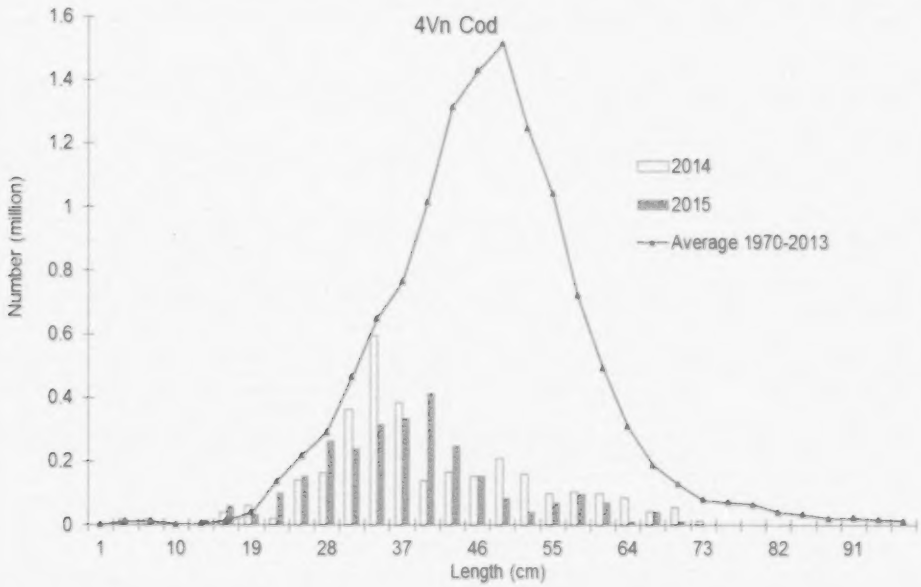

Figure 3g. Length frequency indices for Atlantic Cod in 4Vn from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

Haddock

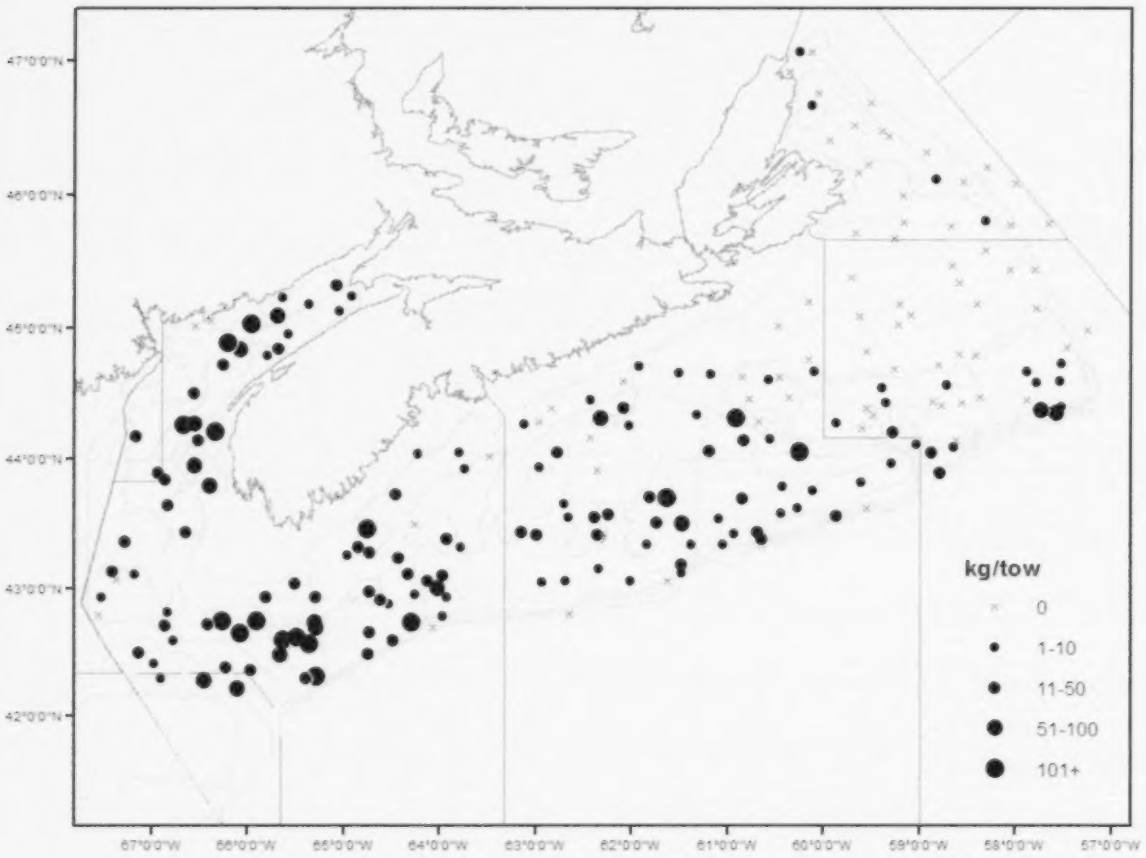

Figure 4a. Distribution of Haddock catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

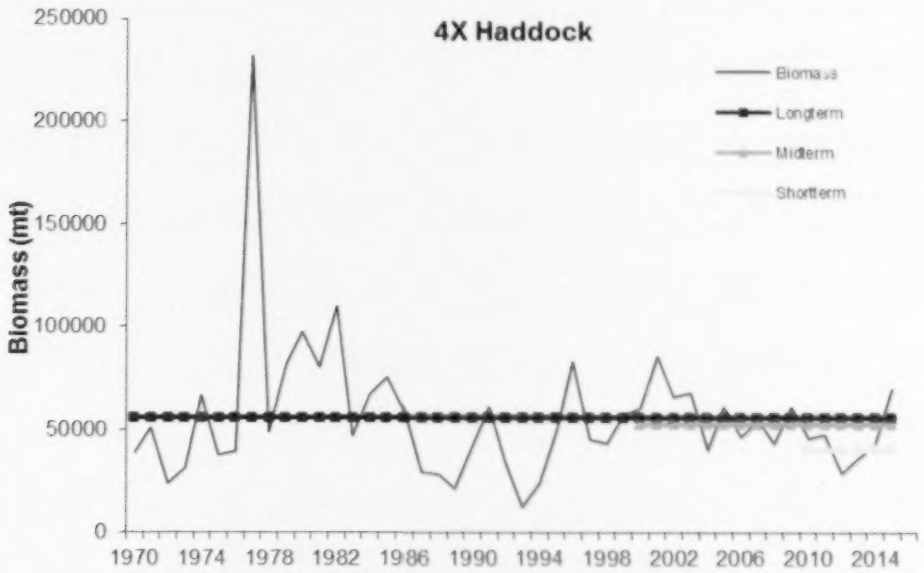

Figure 4b. Biomass index for Haddock in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

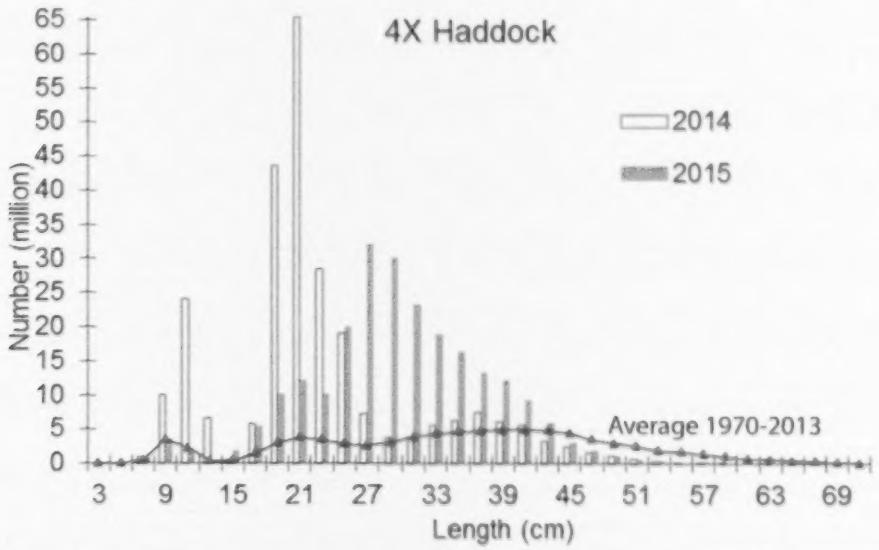

Figure 4c. Length frequency indices for Haddock in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

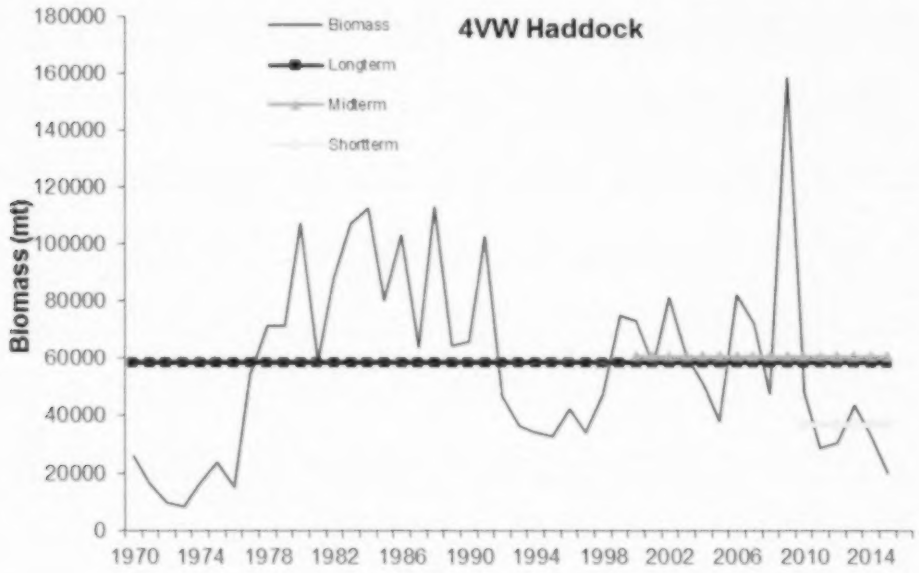

Figure 4d. Biomass index for Haddock in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

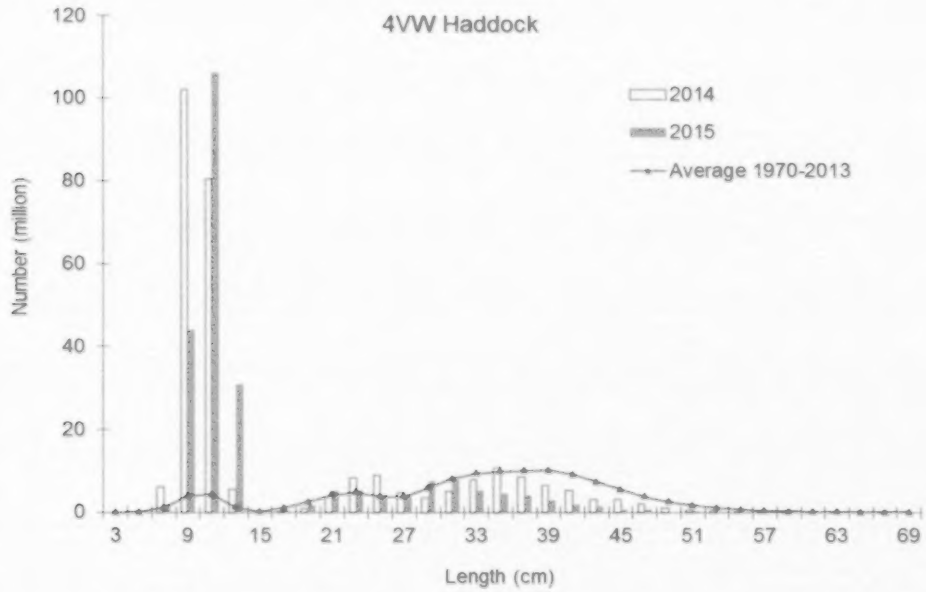

Figure 4e. Length frequency indices for Haddock in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

White Hake

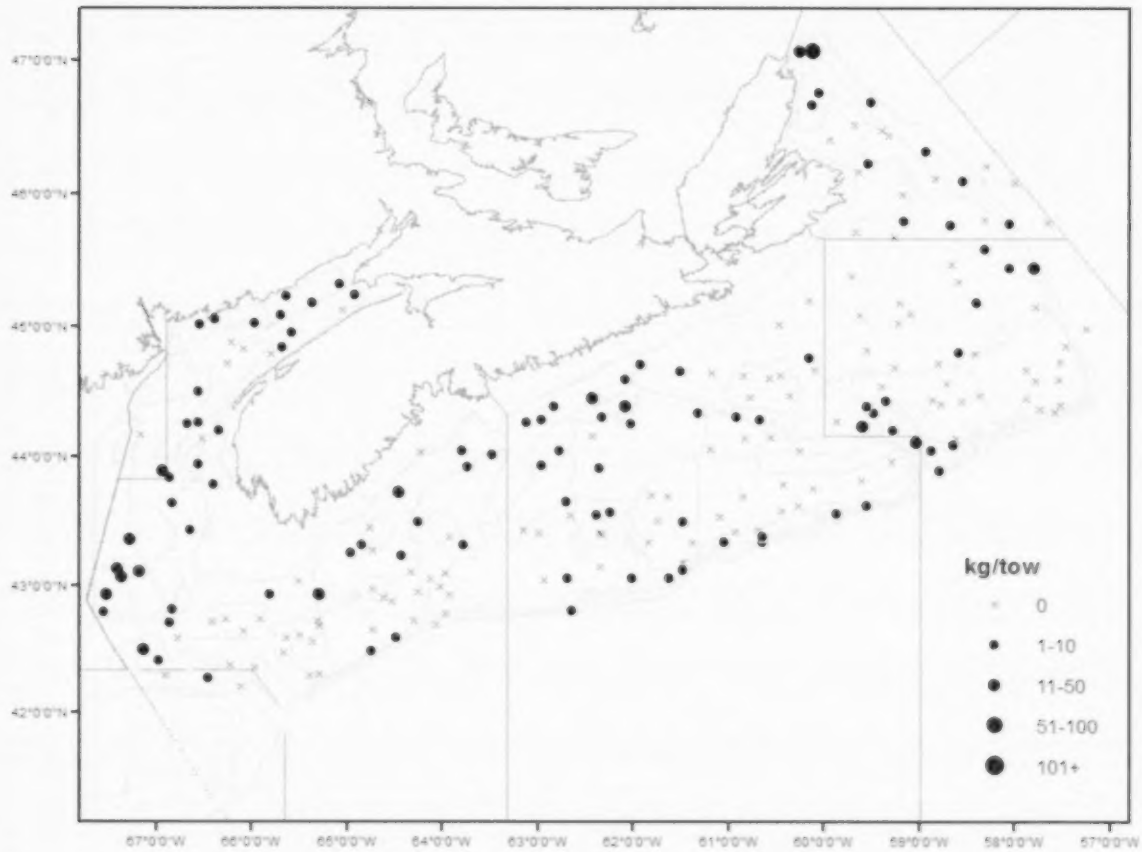

Figure 5a. Distribution of White Hake catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

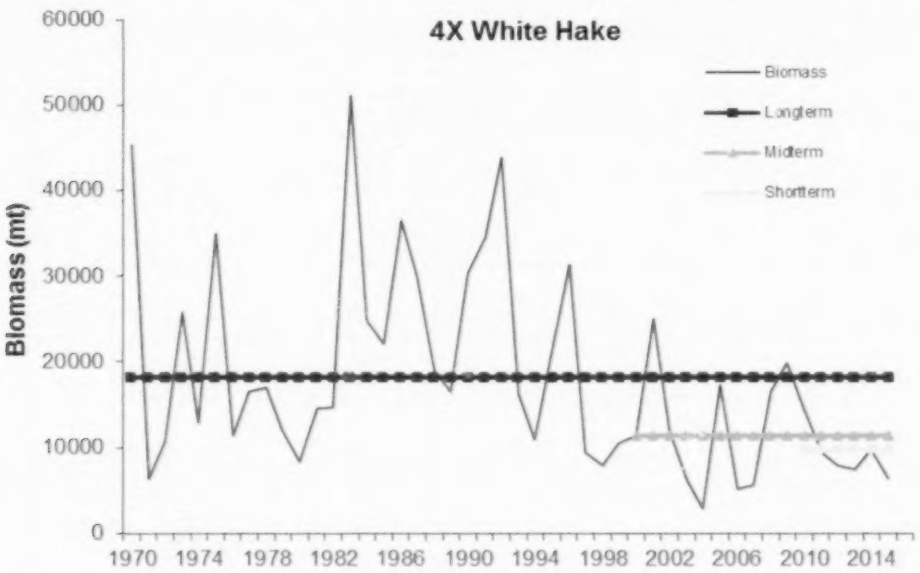

Figure 5b. Biomass index for White Hake in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

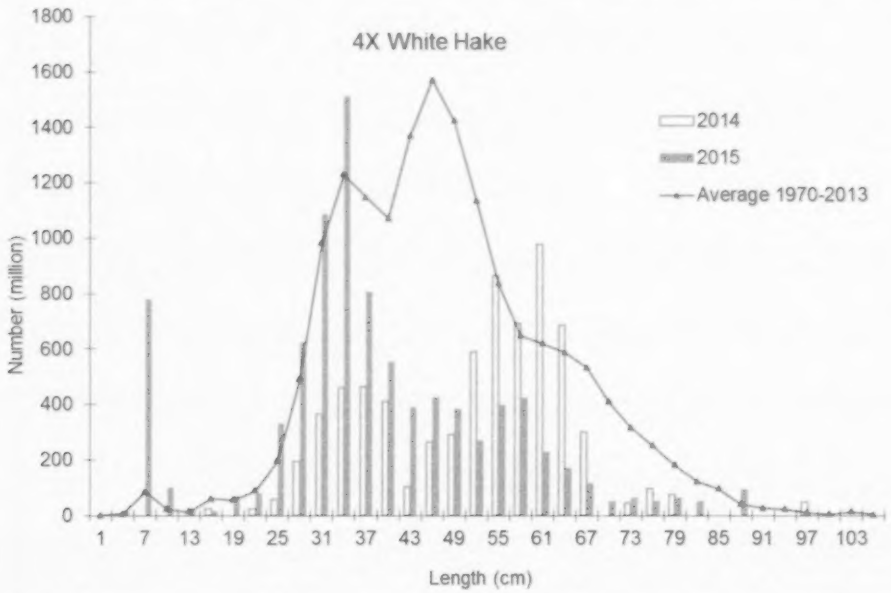

Figure 5c. Length frequency indices for White Hake in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

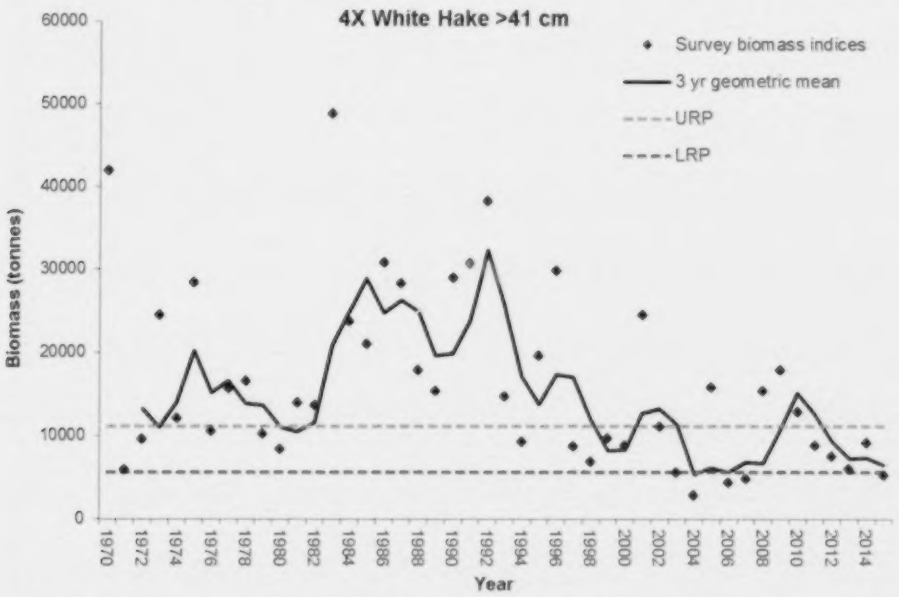

Figure 5d. Biomass index for 4X White Hake >41 cm from the Summer Research Vessel Survey represented by the dark blue diamonds. The solid black line represents the 3 year geometric mean. The dashed blue line represents the lower limit reference point (40% of the average of the survey biomass indices for 1970–2011) and the dashed green line represents the upper limit reference point (80% of the average survey biomass index for 1970–2011).

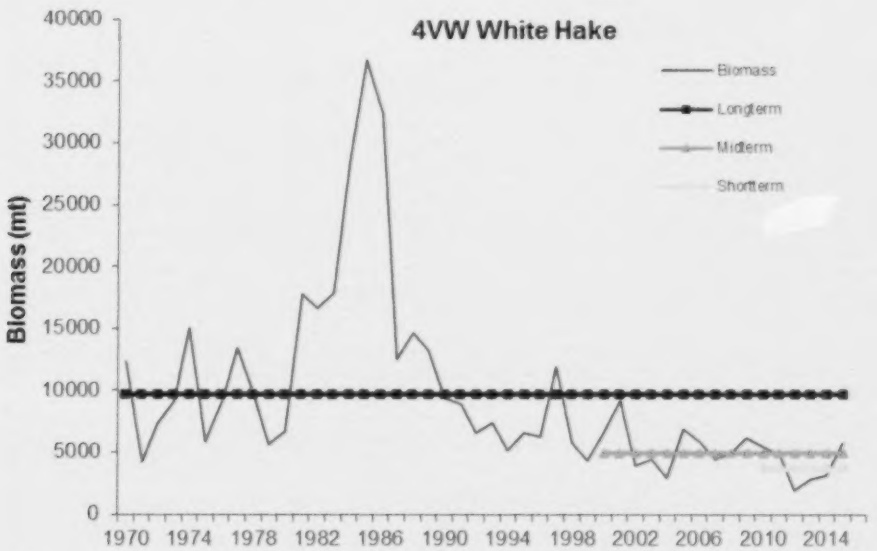

Figure 5e. Biomass index for White Hake in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

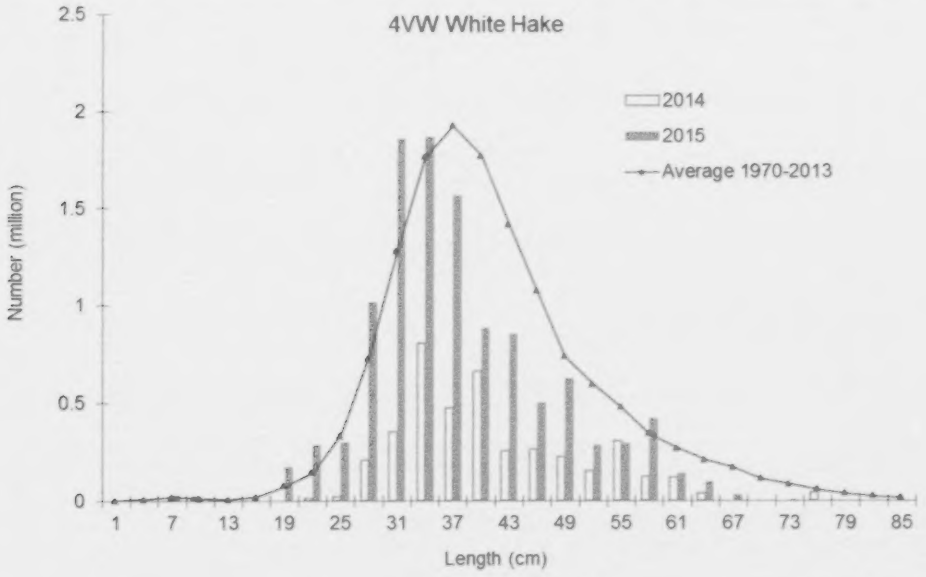

Figure 5f. Length frequency indices for White Hake in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

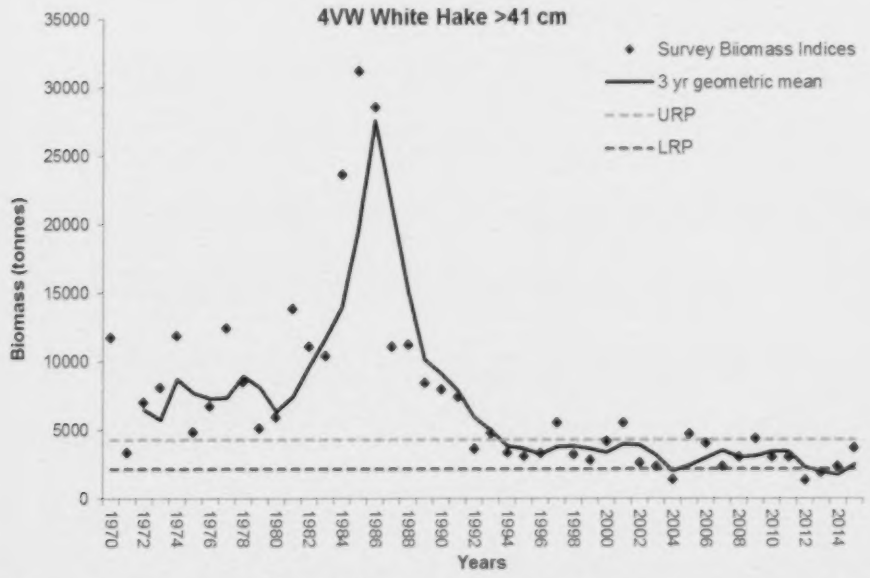

Figure 5g. Biomass index for 4VW White Hake >41 cm from the Summer Research Vessel Survey represented by the dark blue diamonds. The solid black line represents the 3 year geometric mean. The dashed blue line represents the lower limit reference point (40% of the geometric mean of the survey biomass indices for 1970–2011) and the dashed green line represents the upper limit reference point (80% of the geometric mean of the survey biomass indices for 1970–2011).

Silver Hake

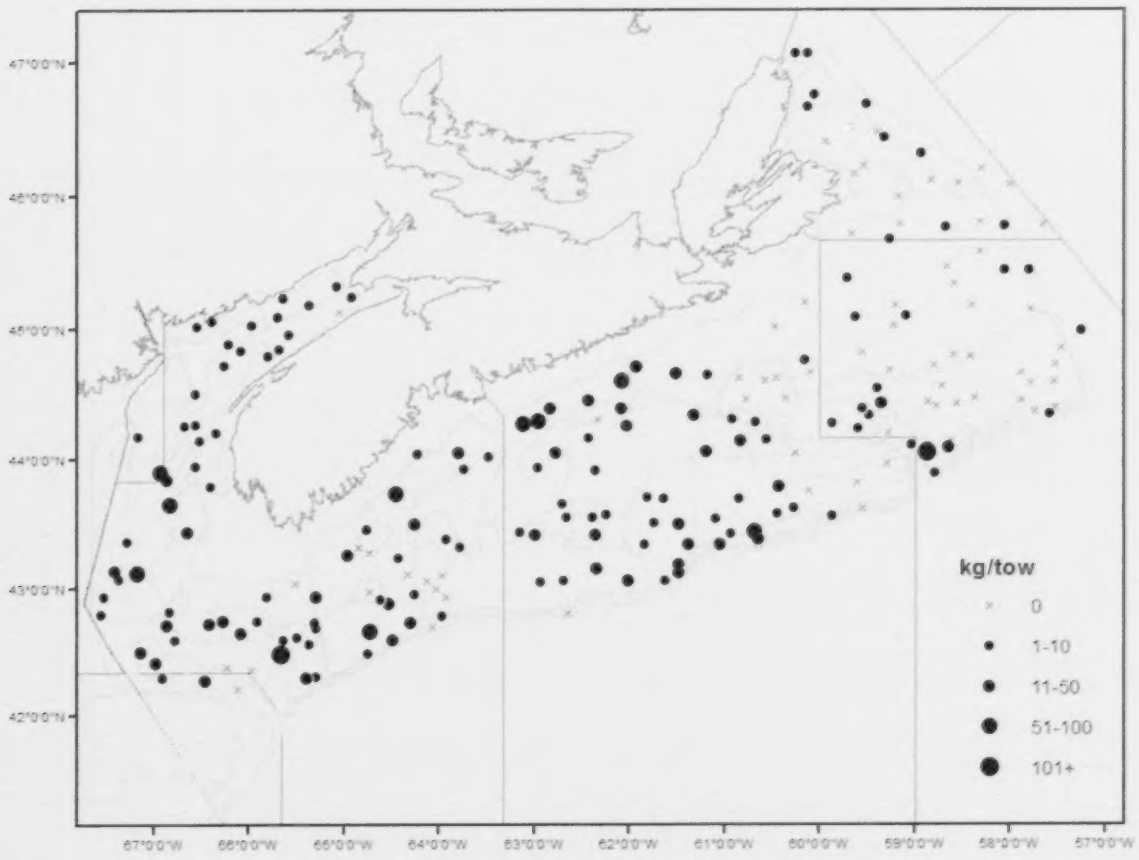

Figure 6a. Distribution of Silver Hake catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

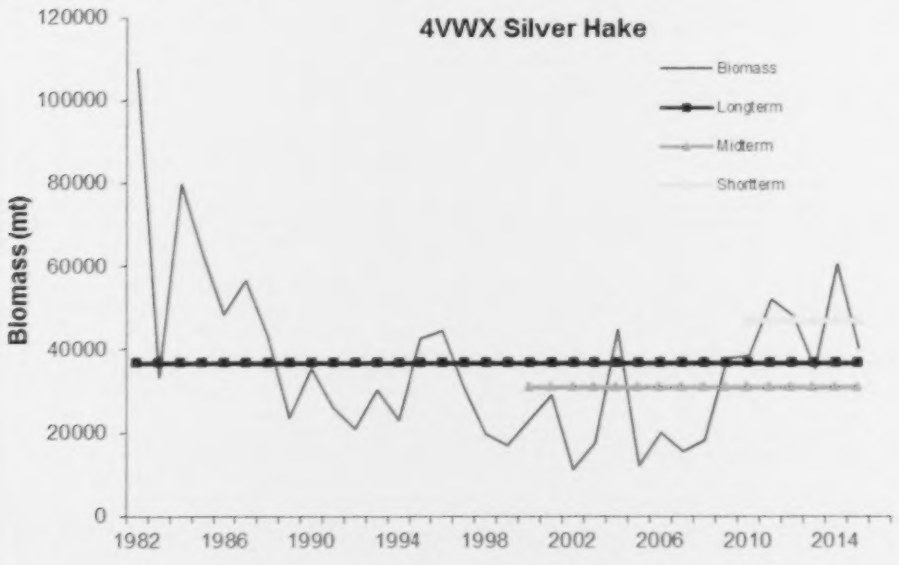

Figure 6b. Biomass index for Silver Hake in 4VWX (strata 440-483) from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

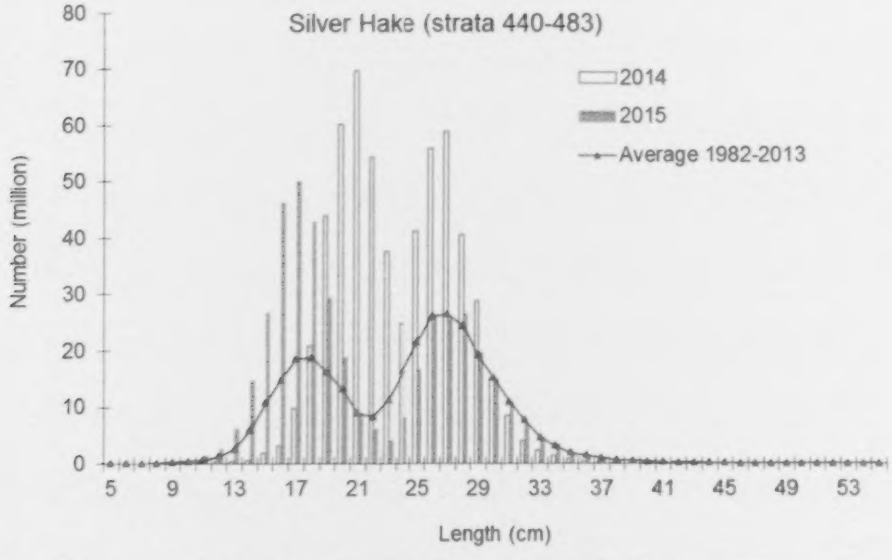

Figure 6c. Length frequency indices for Silver Hake in 4VWX from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1982-2013.

Pollock

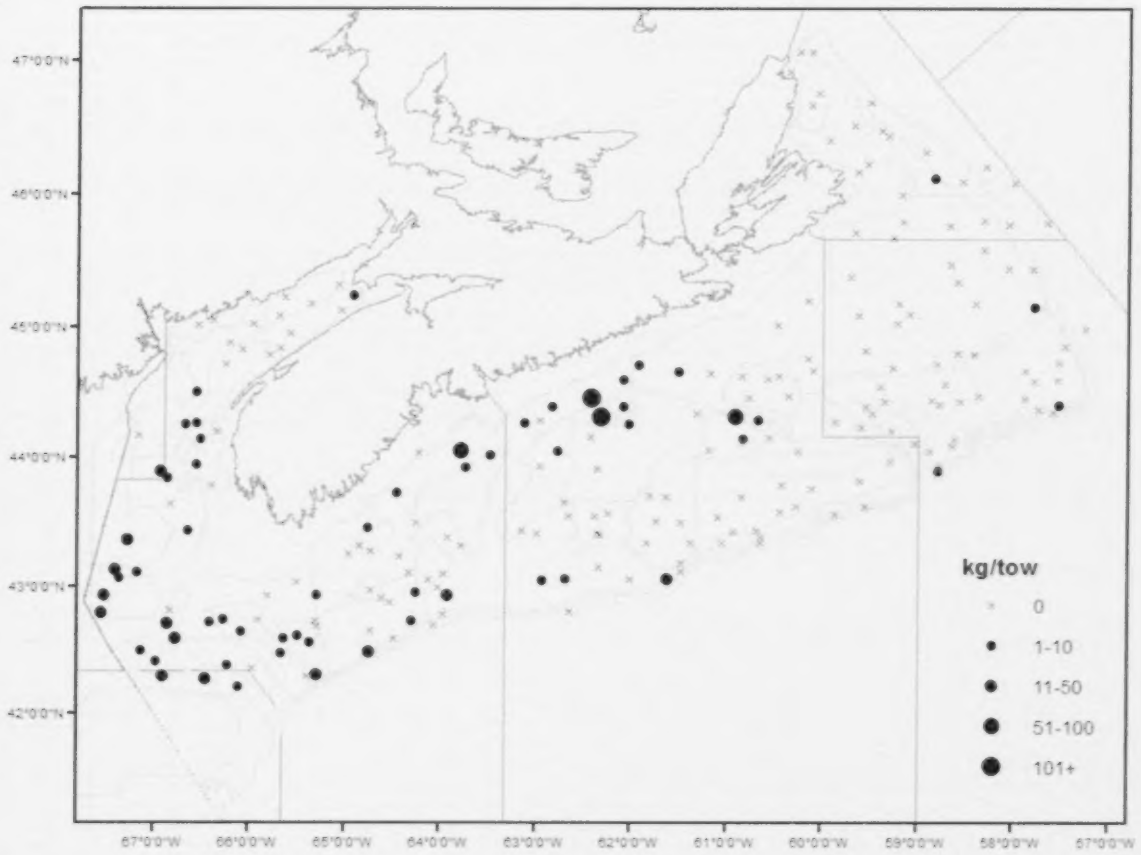

Figure 7a. Distribution of Pollock catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

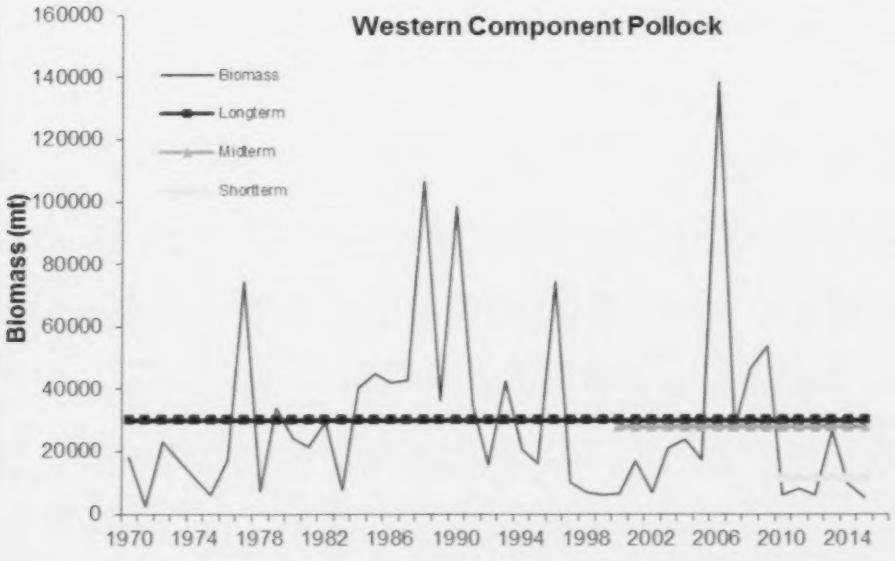

Figure 7b. Biomass index for Western Component Pollock (strata 474, 476, 480-495) from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

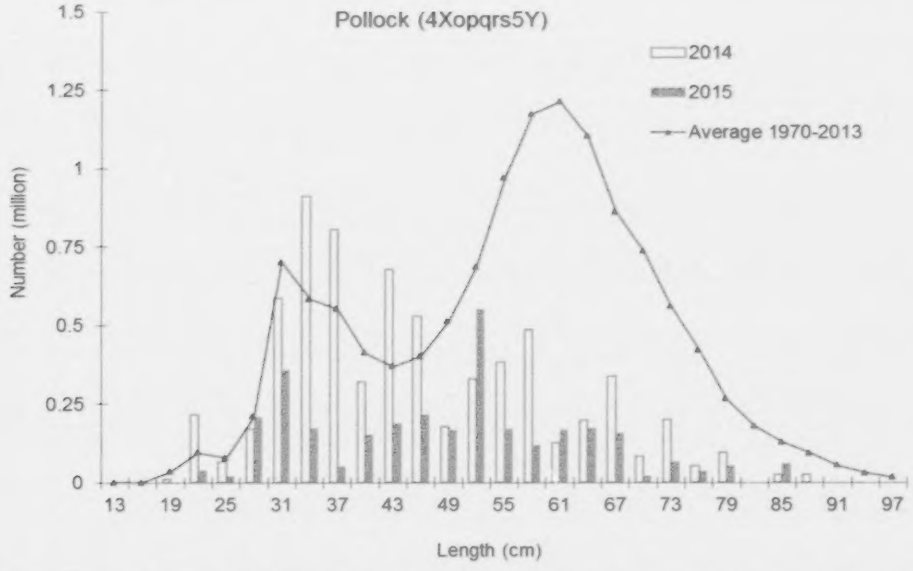

Figure 7c. Length frequency indices for Western Component Pollock from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

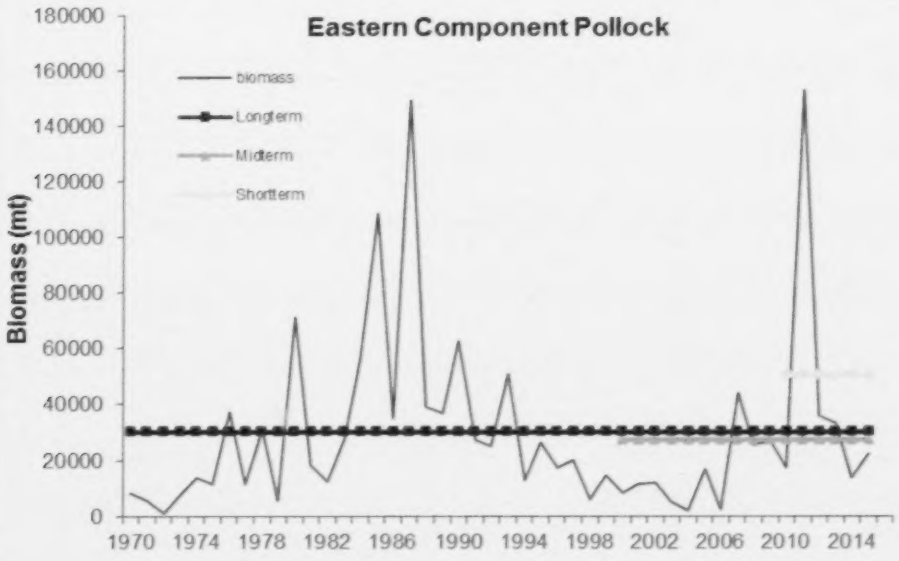

Figure 7d. Biomass index for Eastern Component Pollock (strata 440-473, 475, 477, 478) from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

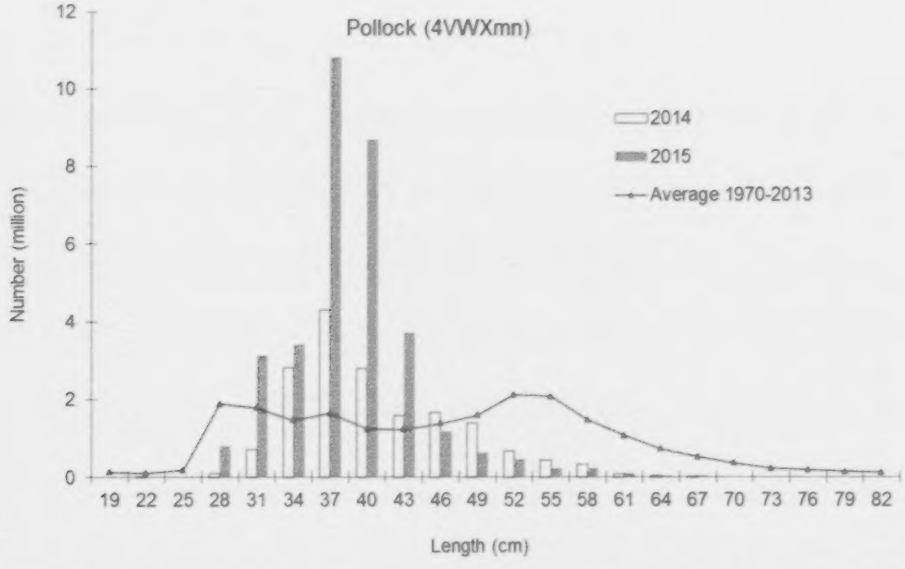

Figure 7e. Length frequency indices for Eastern Component Pollock from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

Redfish

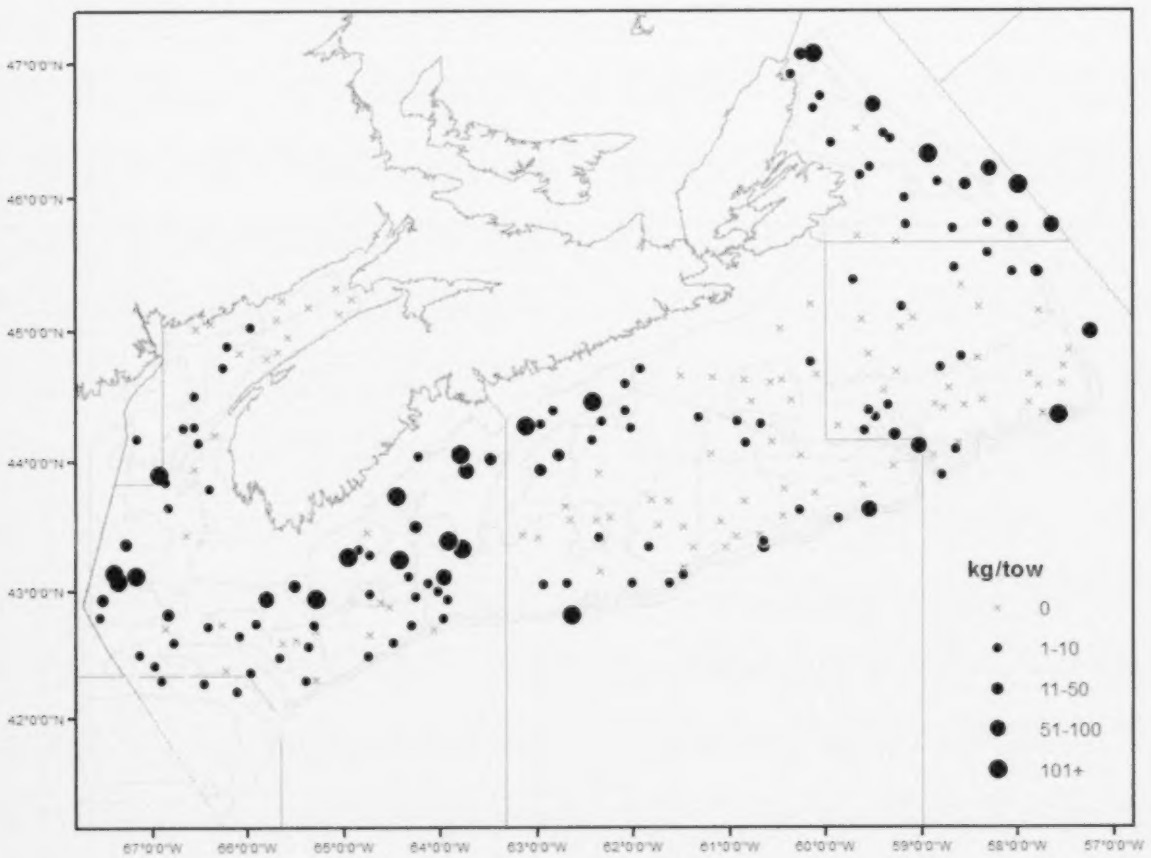

Figure 8a. Distribution of Redfish catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

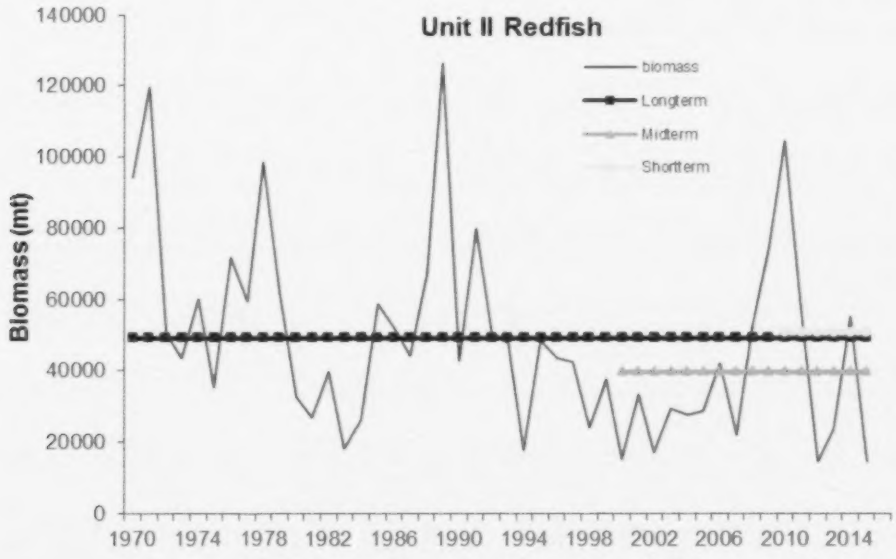

Figure 8b. Biomass index for Unit II Redfish (strata 440-456, 464)) from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

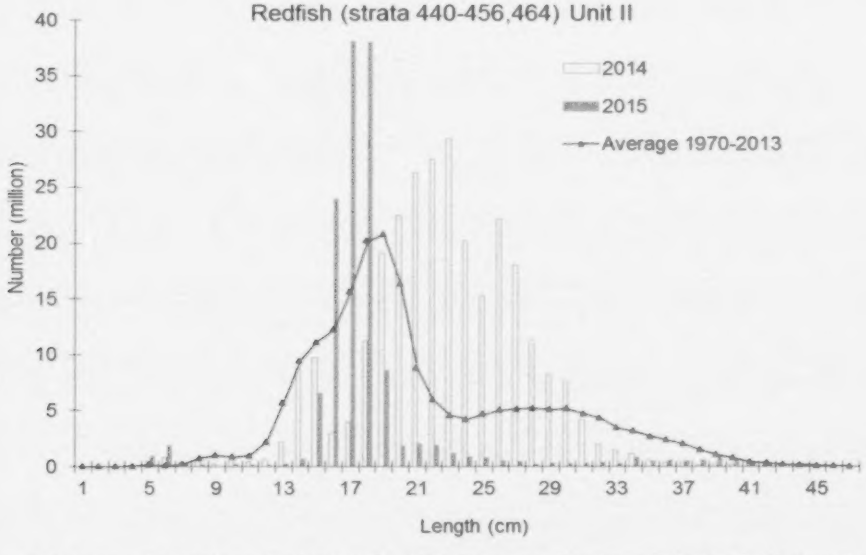

Figure 8c. Length frequency indices for Unit II Redfish from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

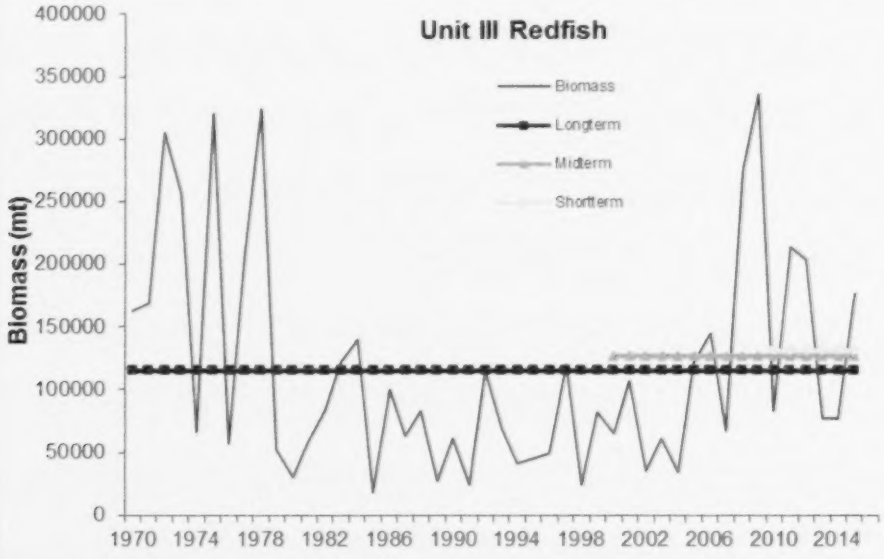

Figure 8d. Biomass index for Unit III Redfish (strata 457-463, 465-485) from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

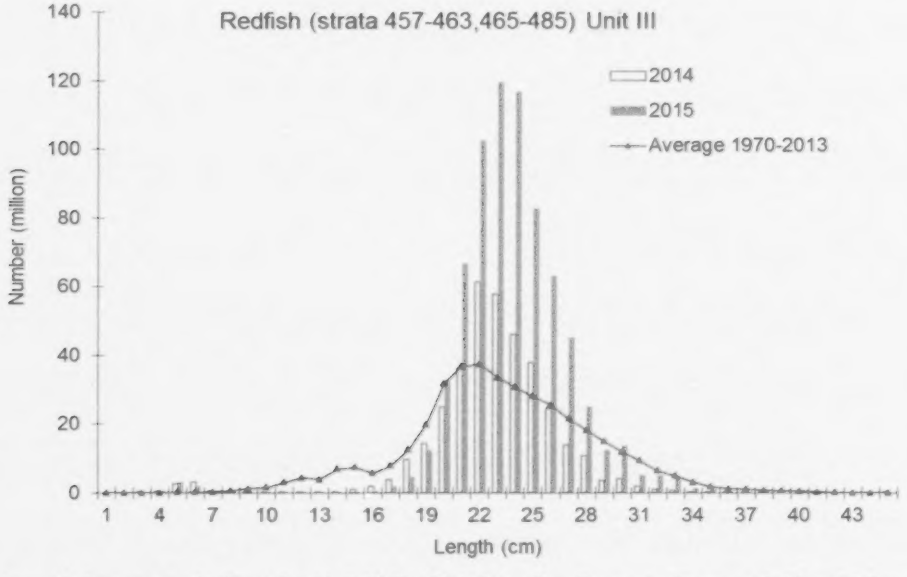

Figure 8e. Length frequency indices for Unit III Redfish from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

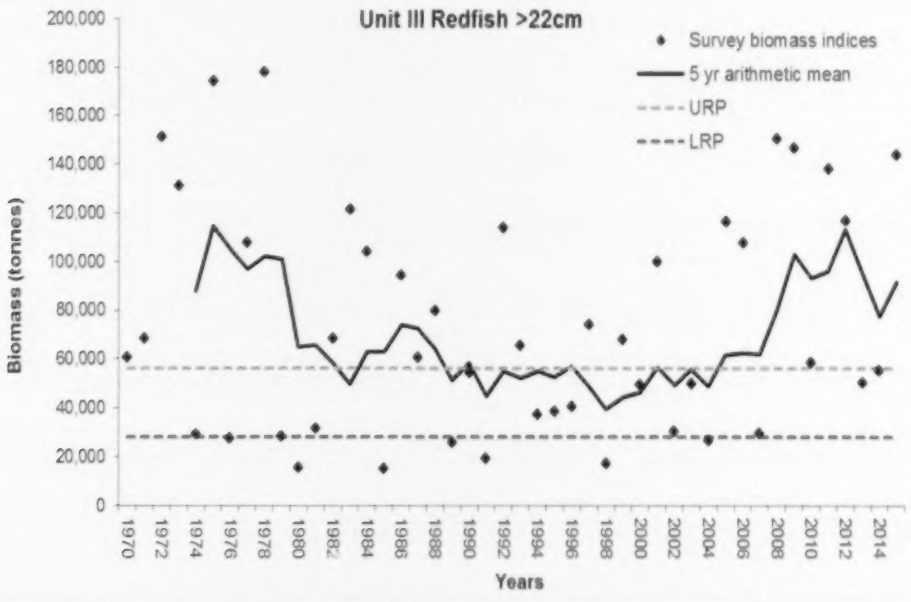

Figure 8f. Biomass index for Unit III redfish > 22cm from the Summer Research Vessel Survey represented by the dark blue diamonds. The solid black line represents the 5 year arithmetic mean. The dashed blue line represents the lower limit reference point and the dashed green line represents the upper limit reference point.

Atlantic Halibut

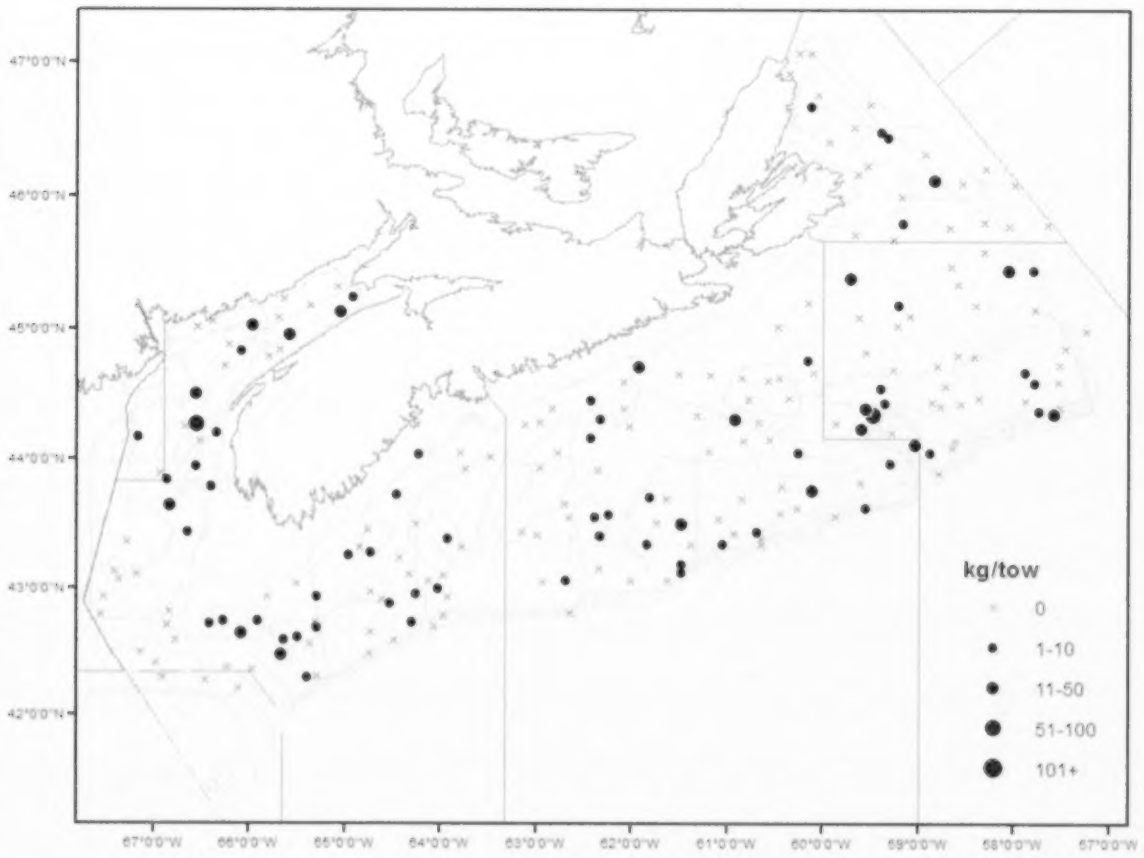

Figure 9a. Distribution of Atlantic Halibut catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

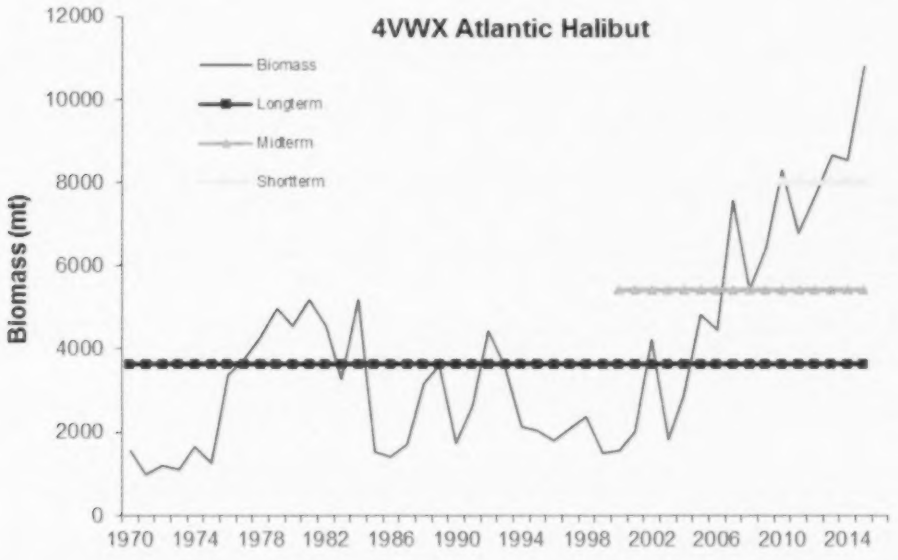

Figure 9b. Biomass index for Atlantic Halibut in 4VWX from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

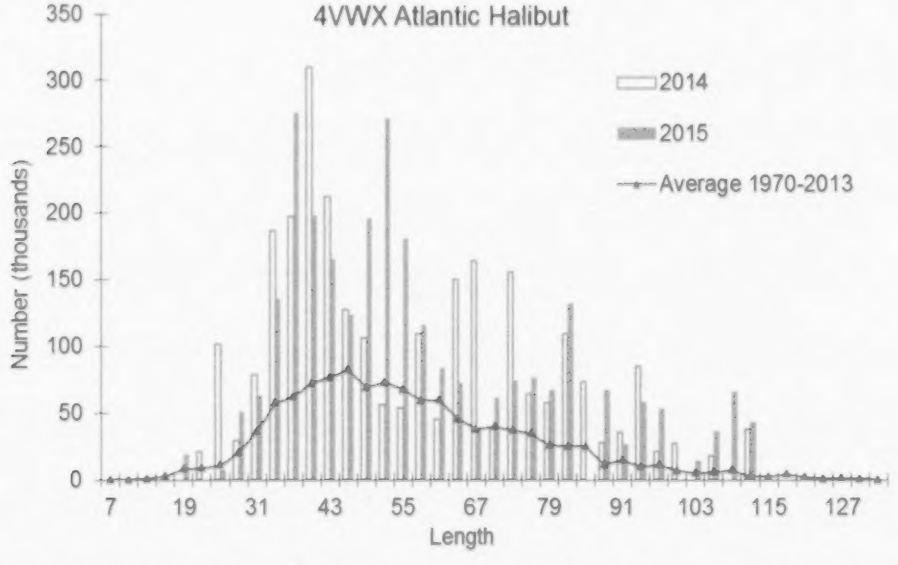

Figure 9c. Length frequency indices for Atlantic Halibut in 4VWX from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Yellowtail Flounder

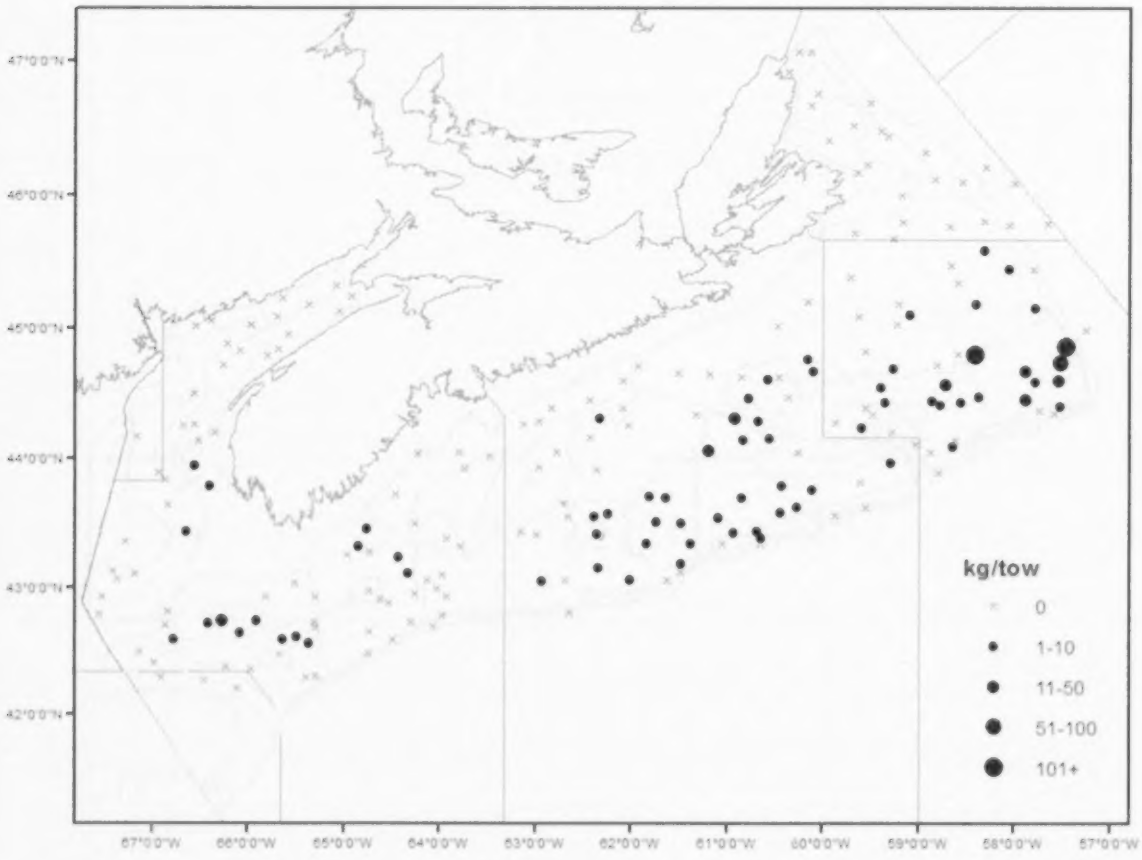

Figure 10a. Distribution of Yellowtail Flounder catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

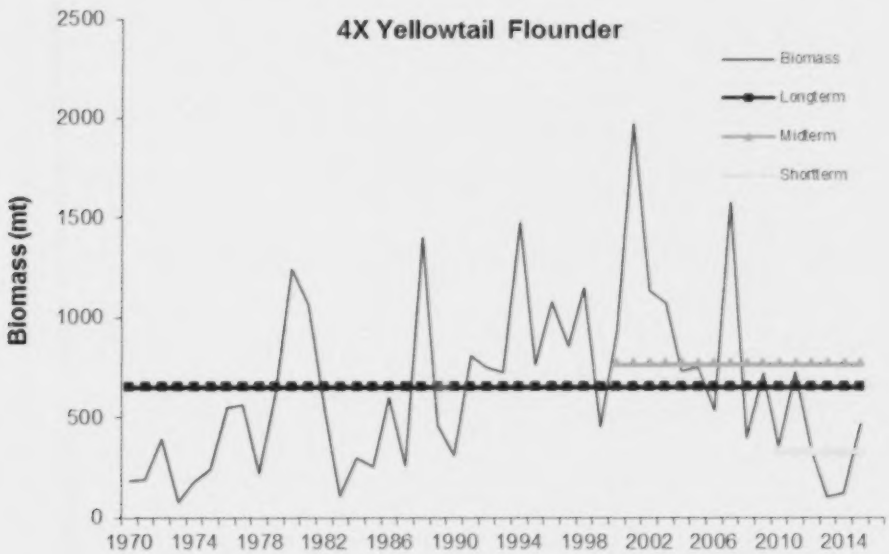

Figure 10b. Biomass index for Yellowtail Flounder in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

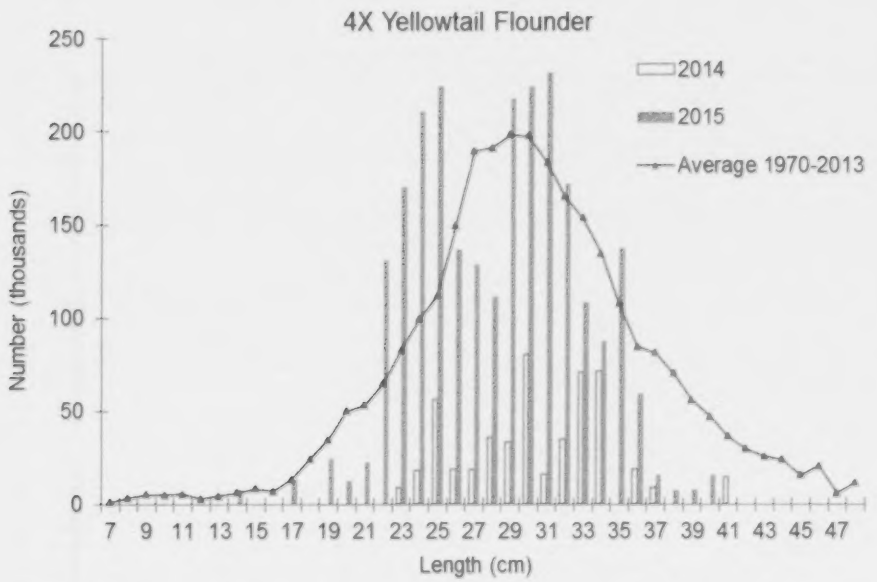

Figure 10c. Length frequency indices for Yellowtail Flounder in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

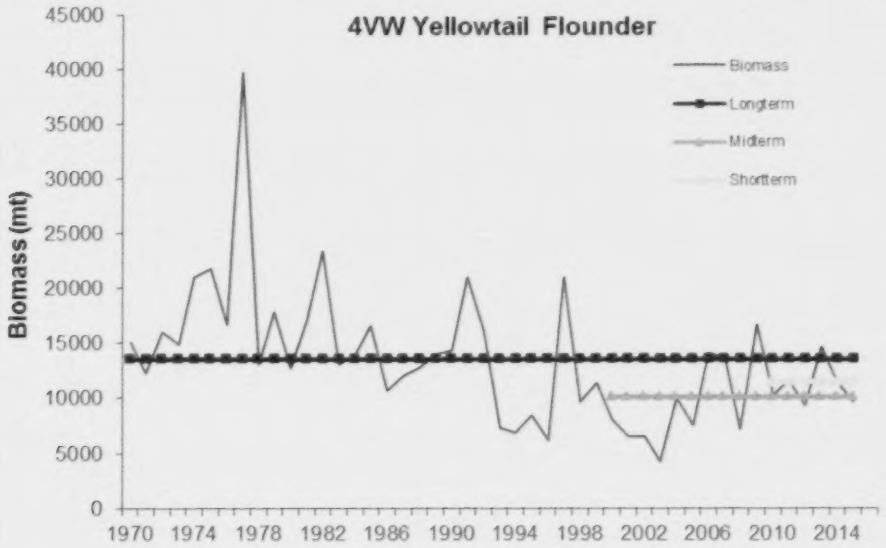

Figure 10d. Biomass index for Yellowtail Flounder in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

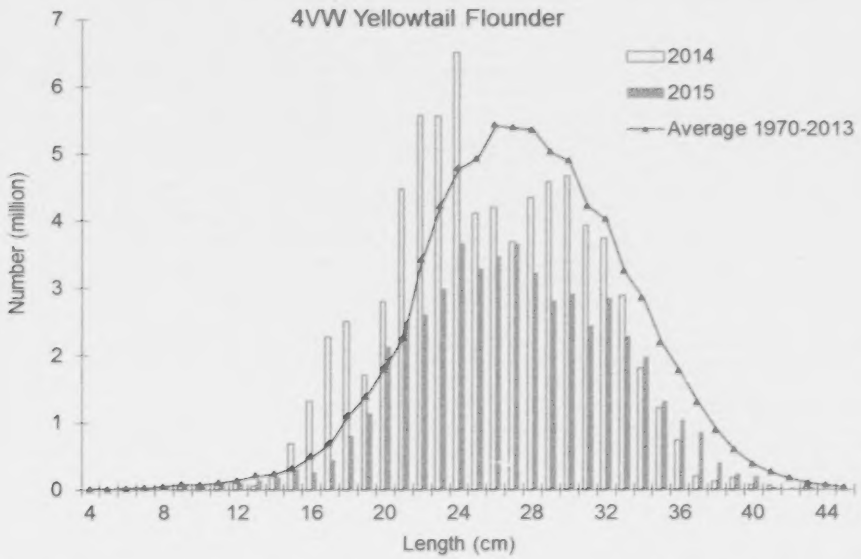

Figure 10e. Length frequency indices for Yellowtail Flounder in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

American Plaice

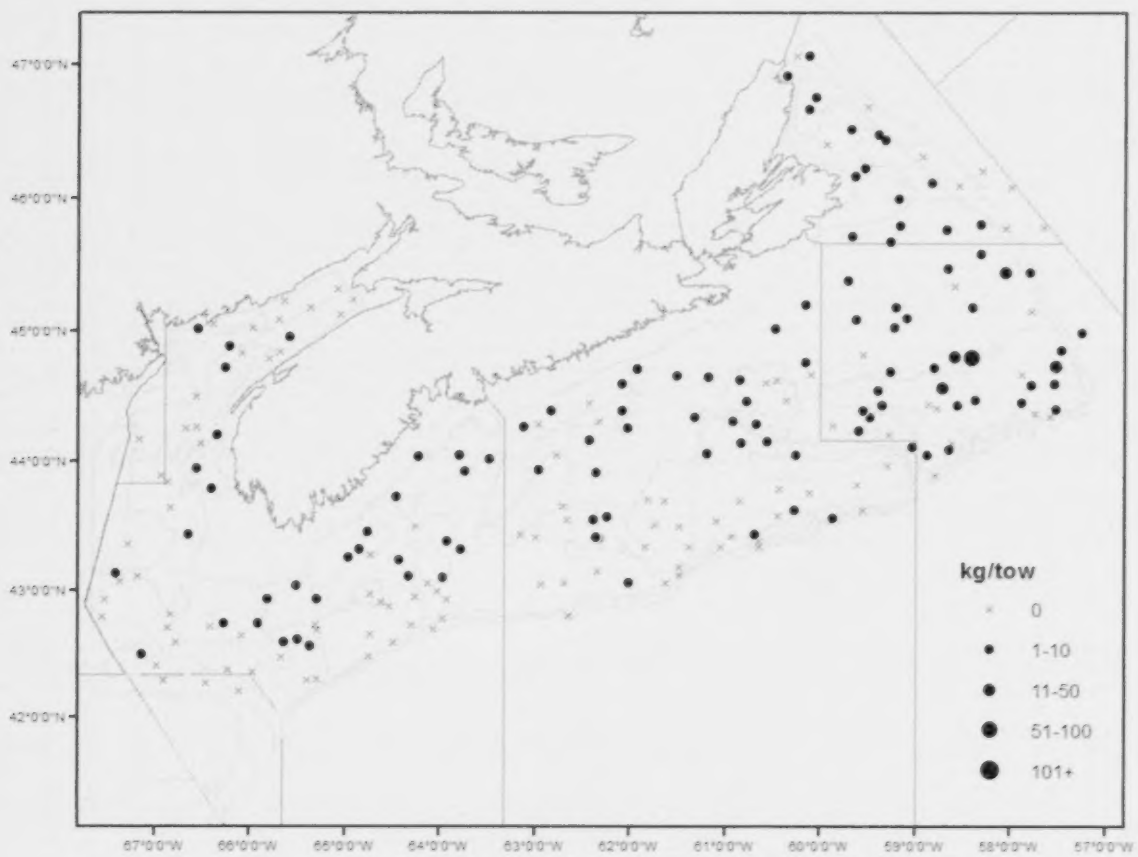

Figure 11a. Distribution of American Plaice catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

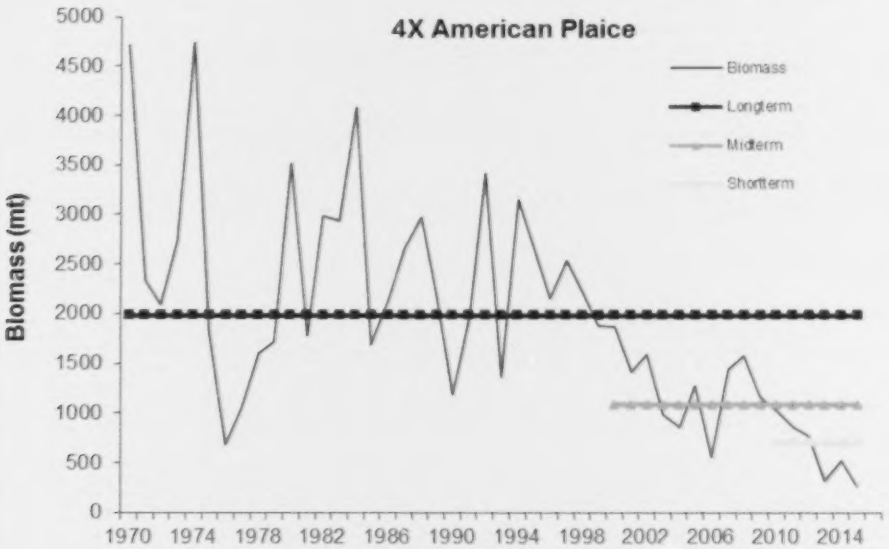

Figure 11b. Biomass index for American Plaice in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

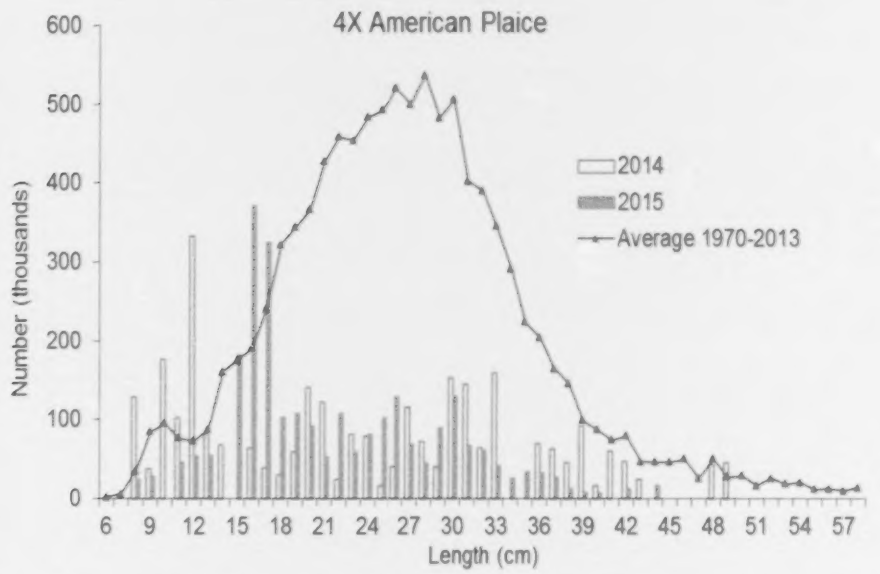

Figure 11c. Length frequency indices for American Plaice in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

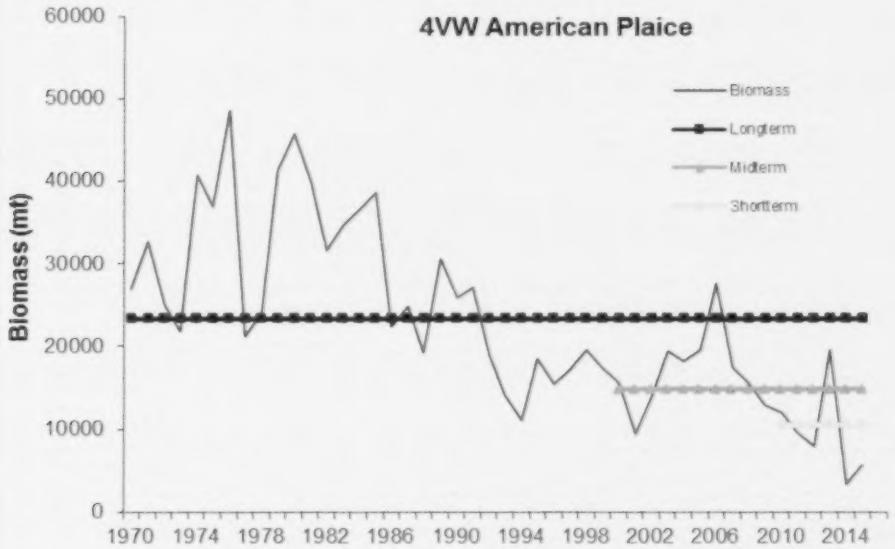

Figure 11d. Biomass index for American Plaice in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

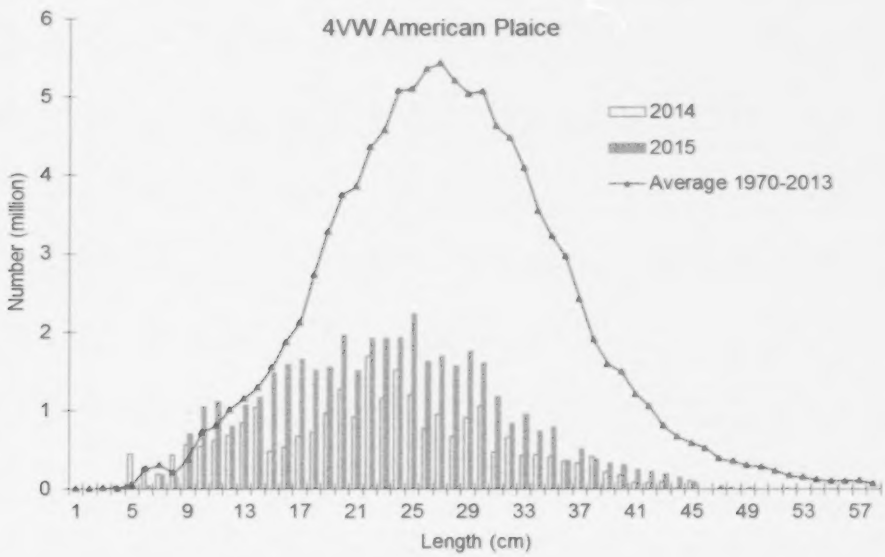

Figure 11e. Length frequency indices for American Plaice in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

Witch Flounder

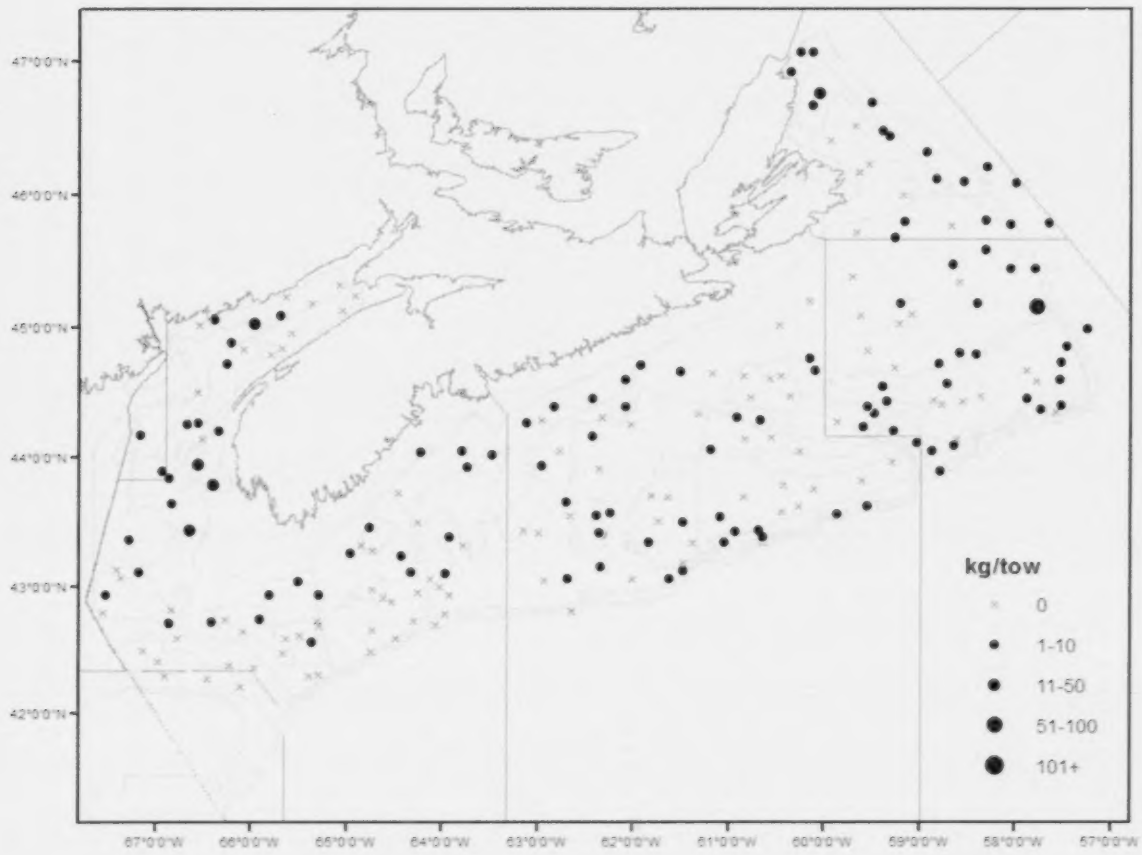

Figure 12a. Distribution of Witch Flounder catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

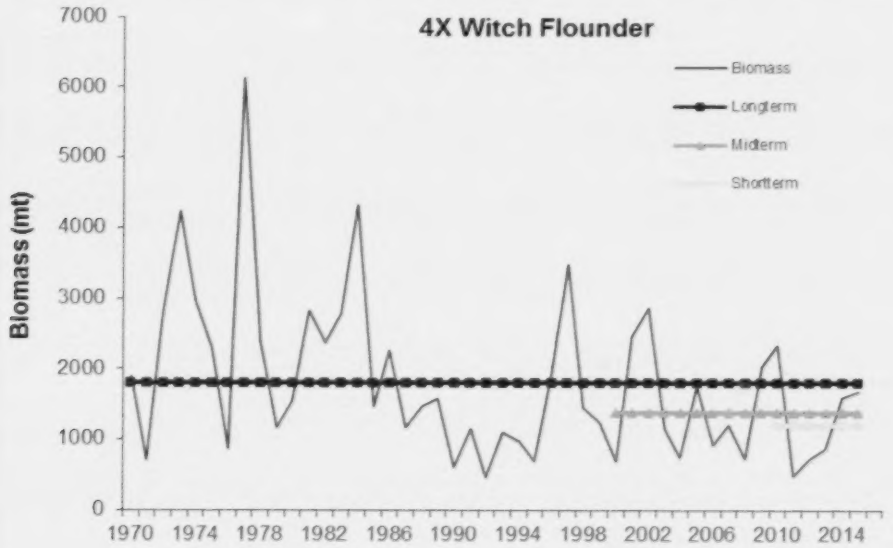

Figure 12b. Biomass index for Witch Flounder in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

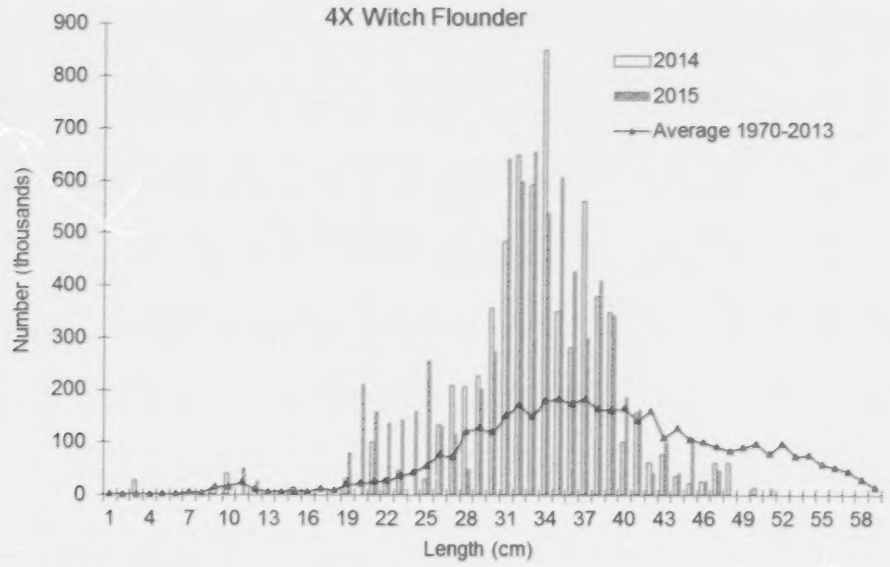

Figure 12c. Length frequency indices for Witch Flounder in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

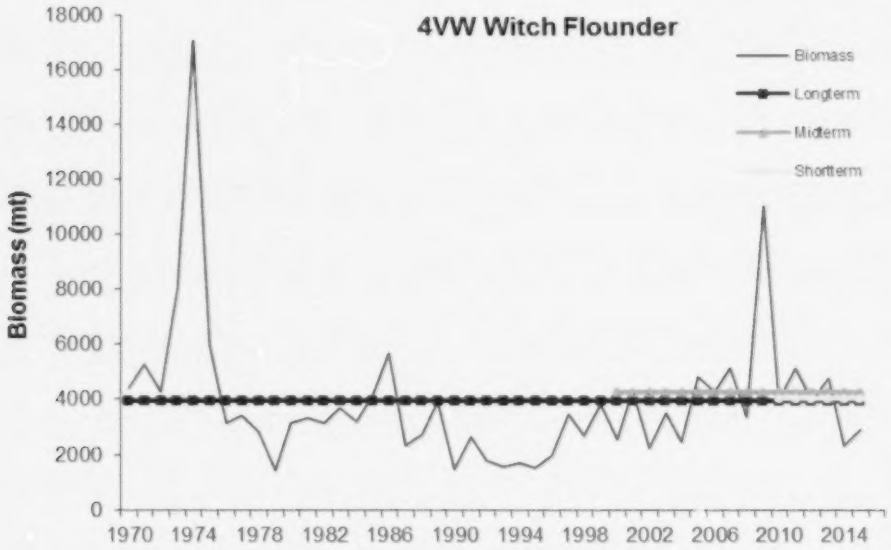

Figure 12d. Biomass index for Witch Flounder in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

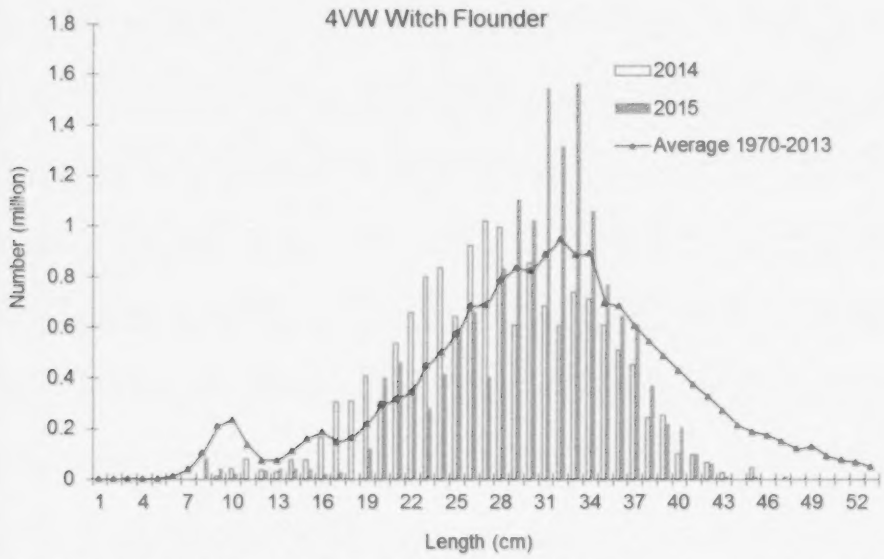

Figure 12e. Length frequency indices for Witch Flounder in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

Winter Flounder

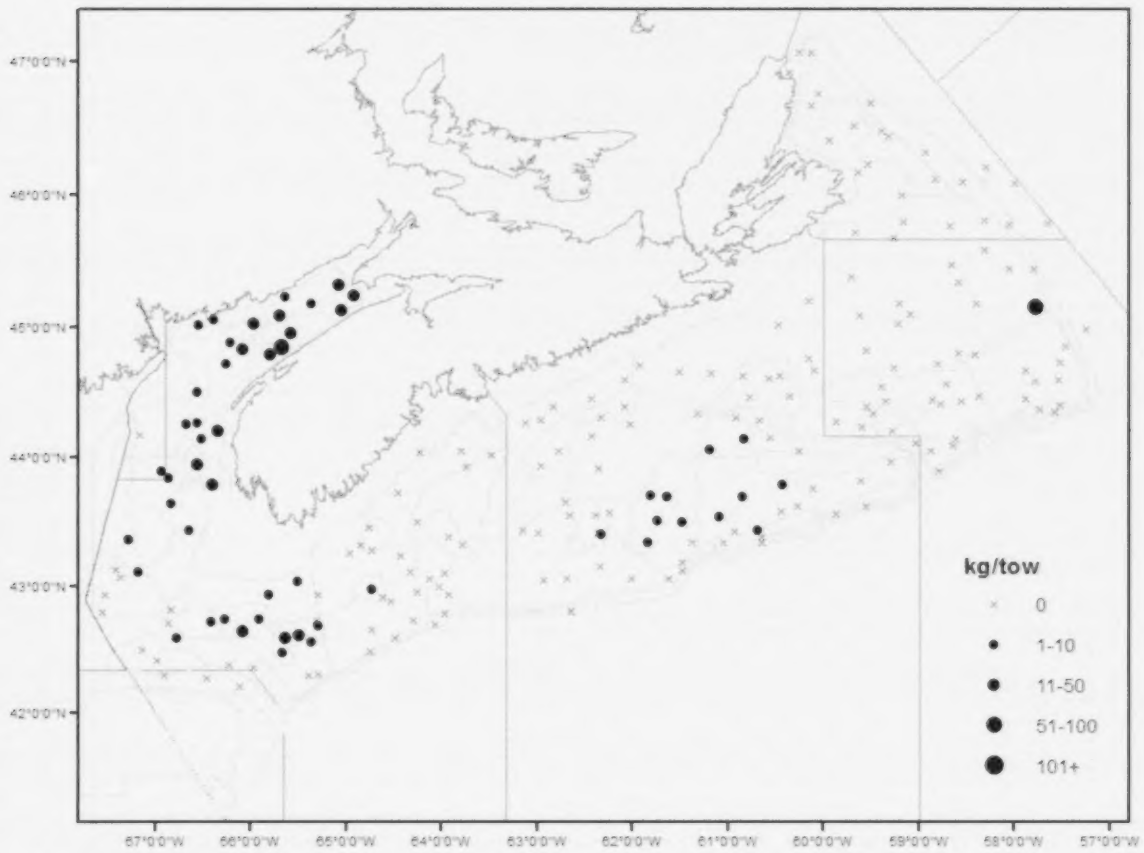

Figure 13a. Distribution of Winter Flounder catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

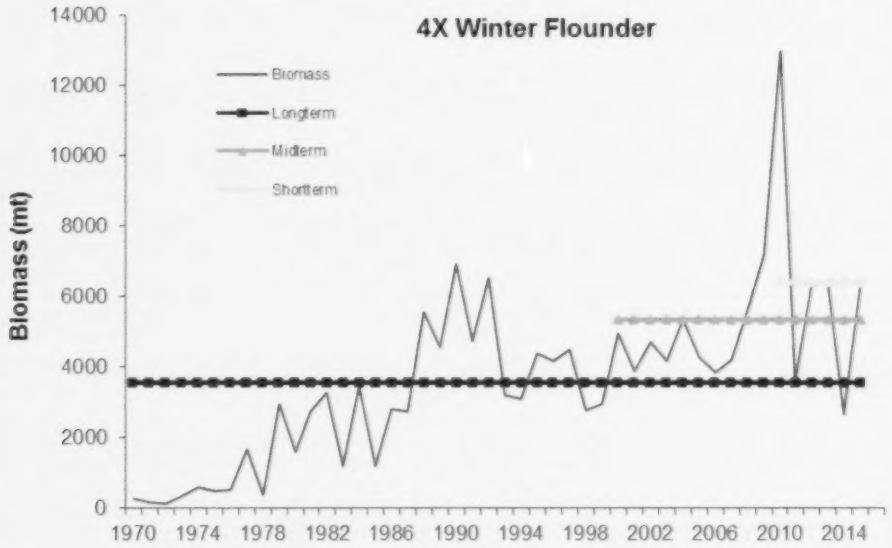

Figure 13b. Biomass index for Winter Flounder in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

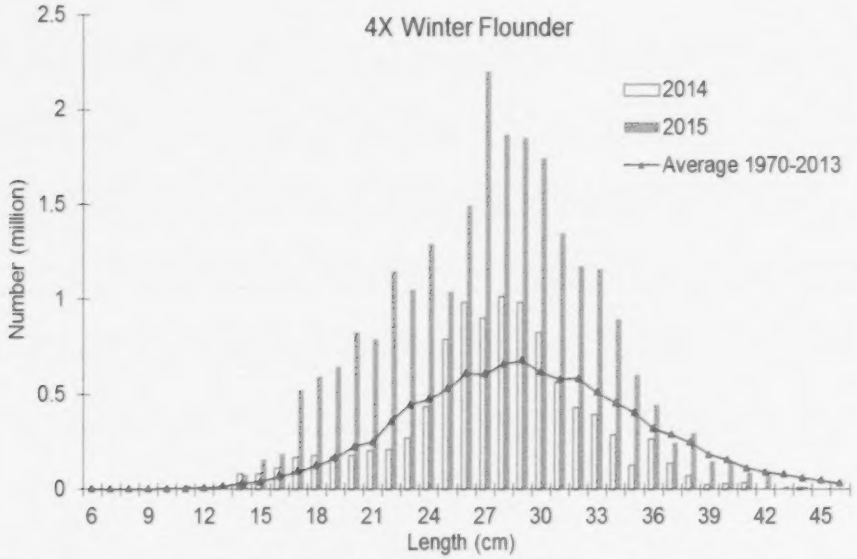

Figure 13c. Length frequency indices for Winter Flounder in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

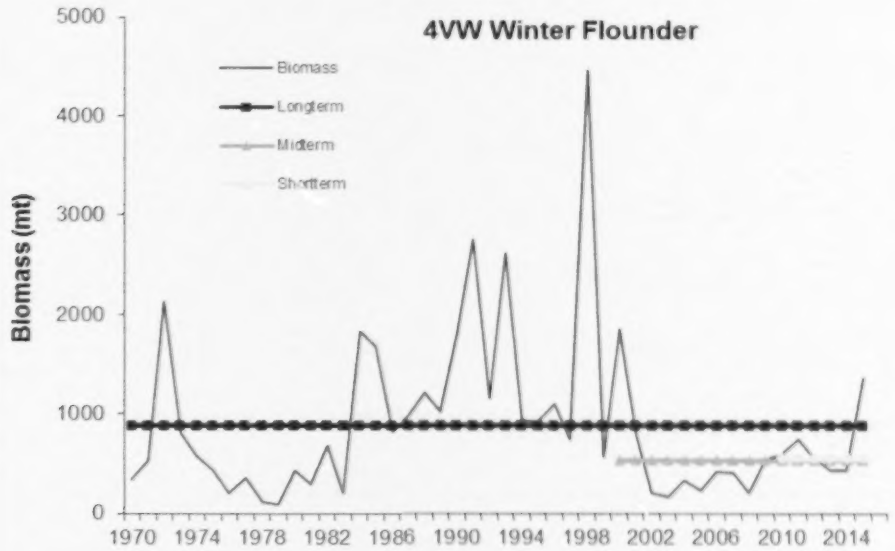

Figure 13d. Biomass index for Winter Flounder in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

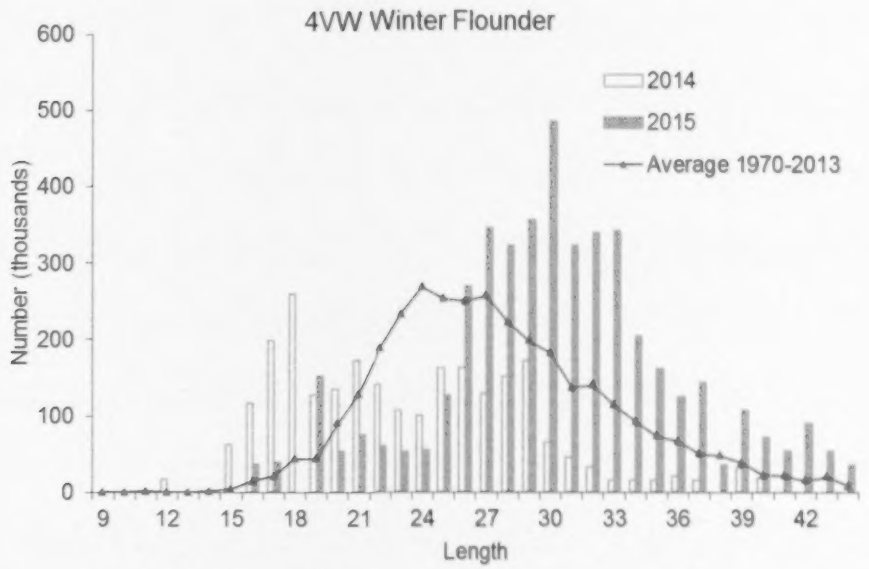

Figure 13e. Length frequency indices for Winter Flounder in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Atlantic Wolffish

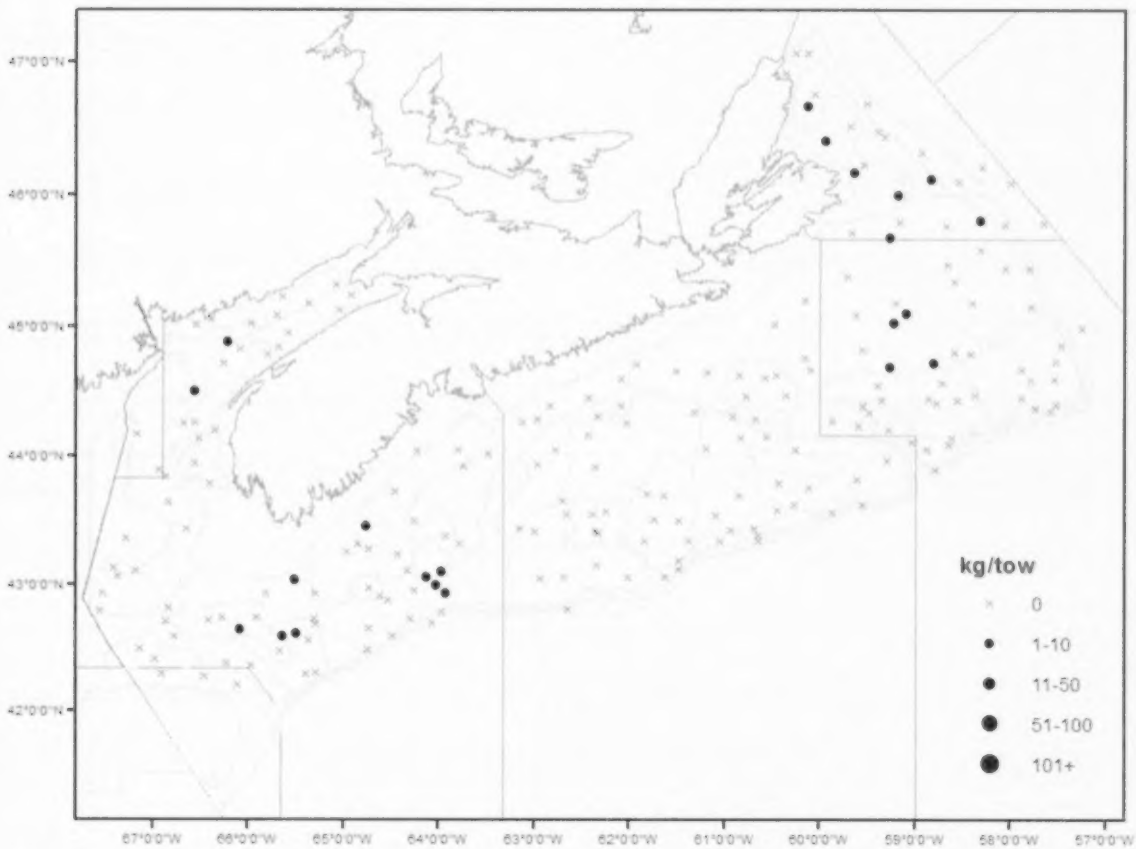

Figure 14a. Distribution of Atlantic Wolffish catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

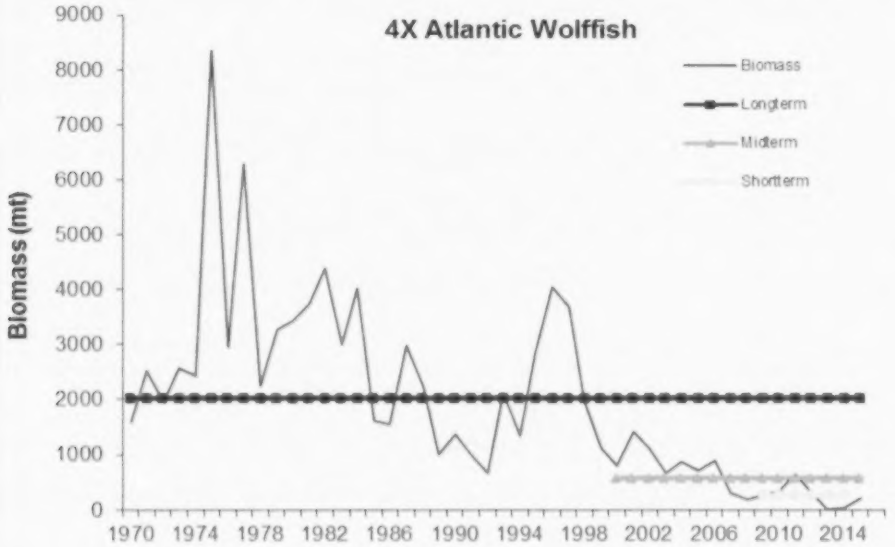

Figure 14b. Biomass index for Atlantic Wolffish in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

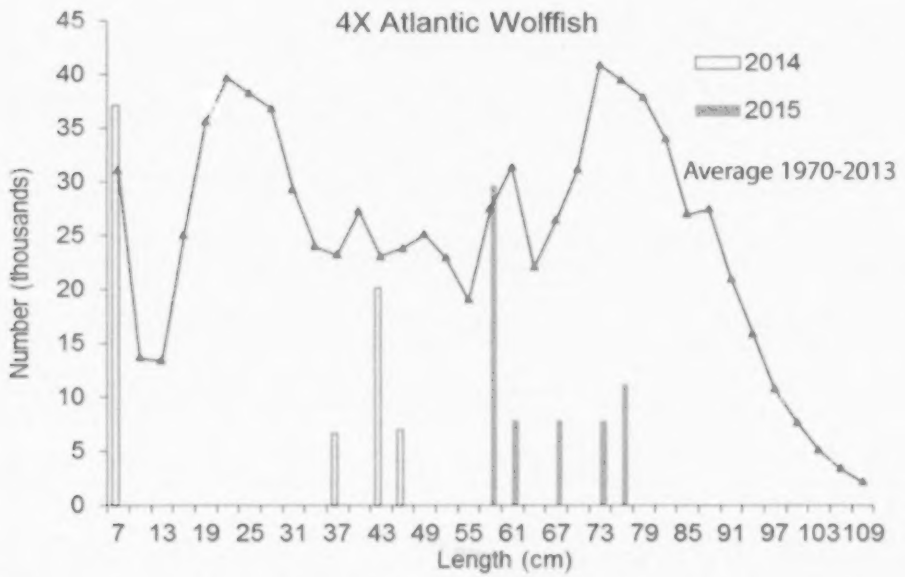

Figure 14c. Length frequency indices for Atlantic Wolffish in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

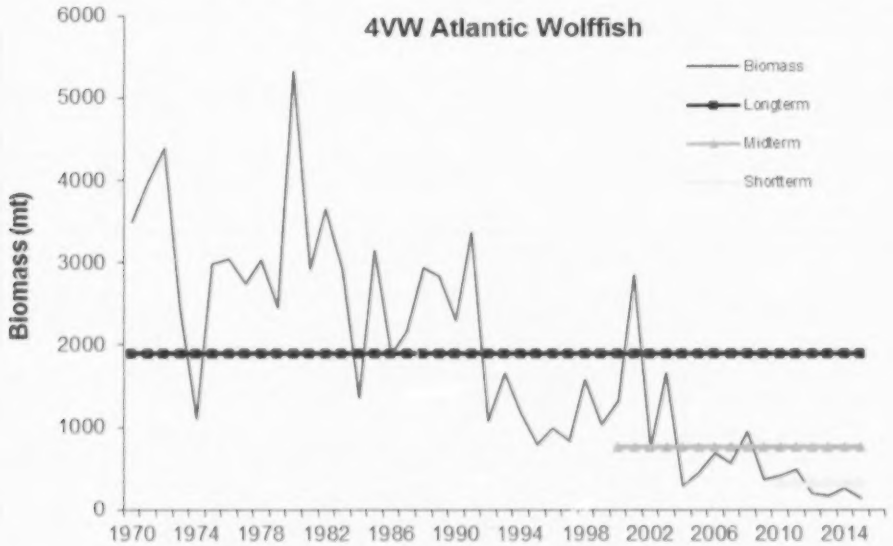

Figure 14d. Biomass index for Atlantic Wolffish in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

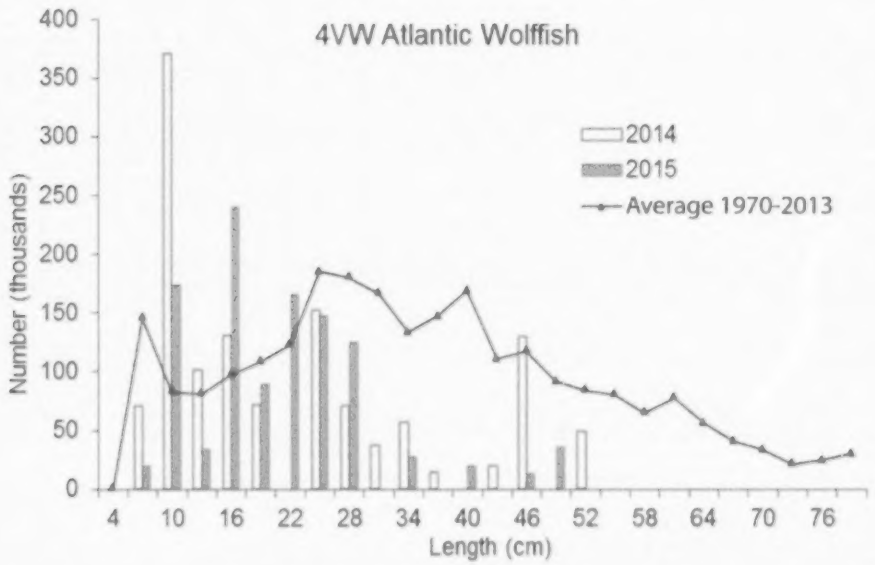

Figure 14e. Length frequency indices for Atlantic Wolffish in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Monkfish

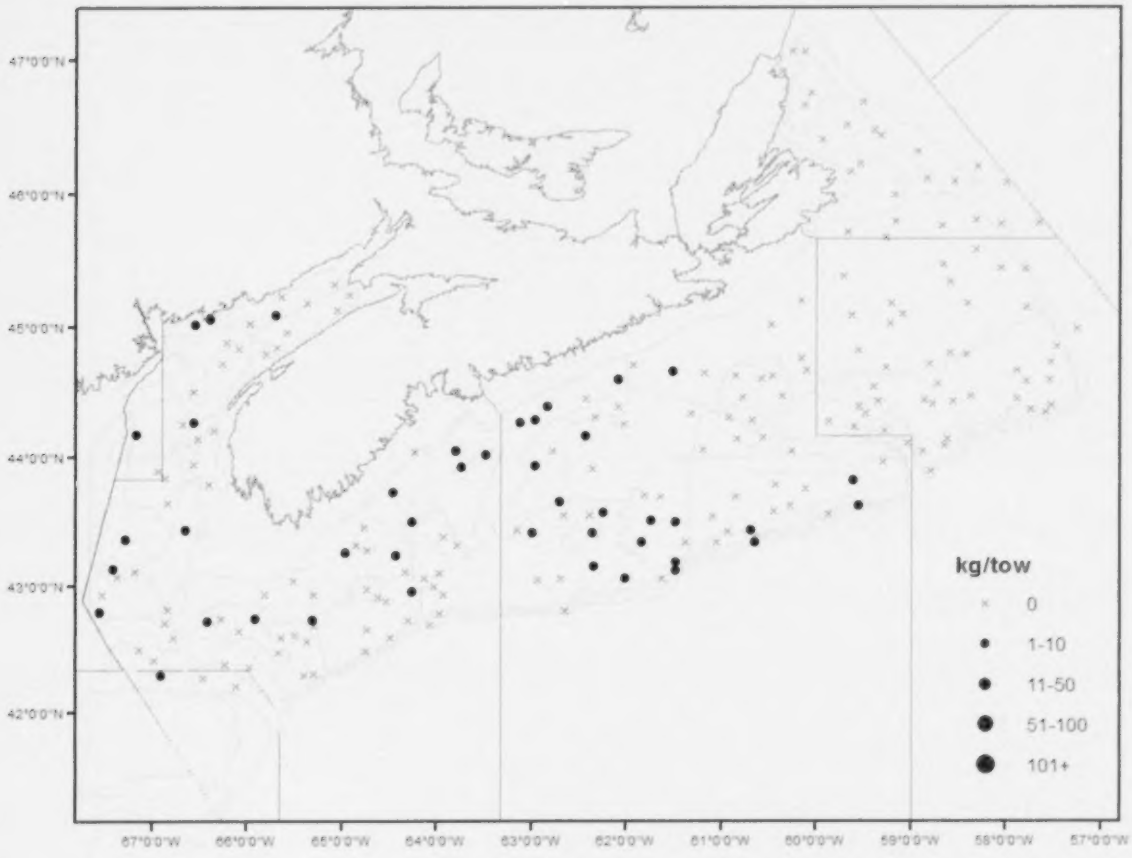

Figure 15a. Distribution of Monkfish catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

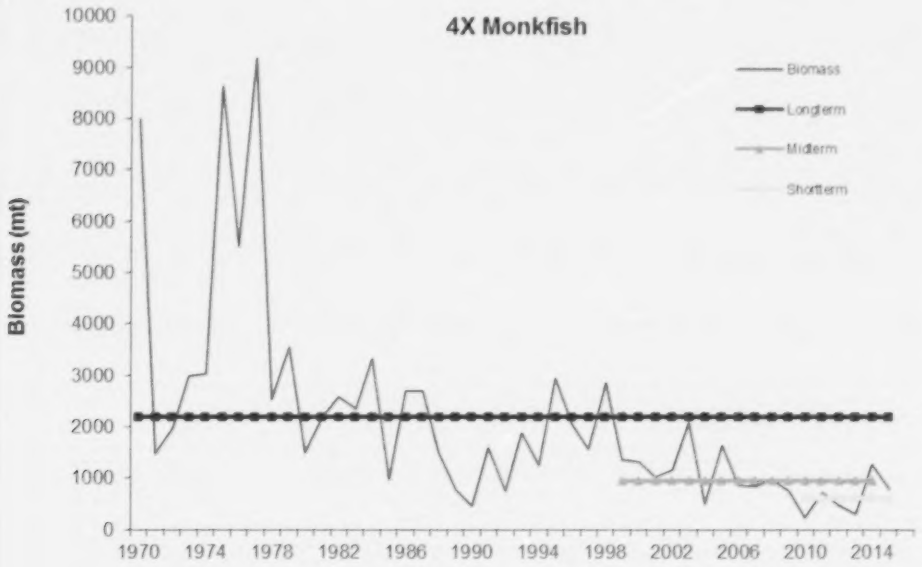

Figure 15b. Biomass index for Monkfish in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

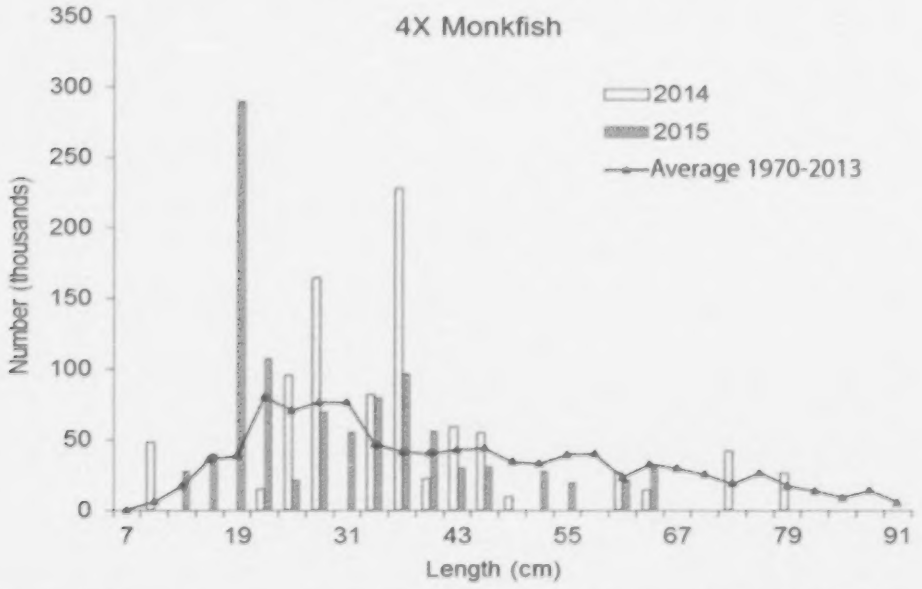

Figure 15c. Length frequency indices for Monkfish in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

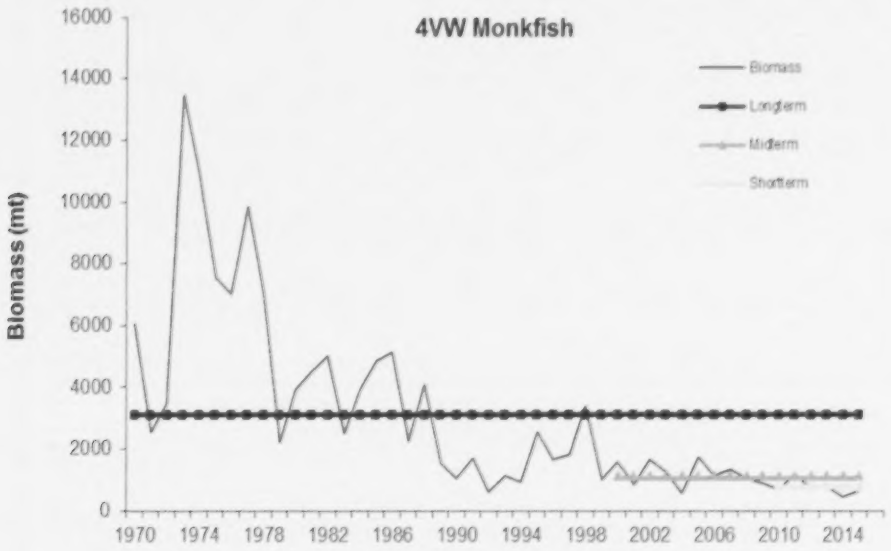

Figure 15d. Biomass index for Monkfish in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

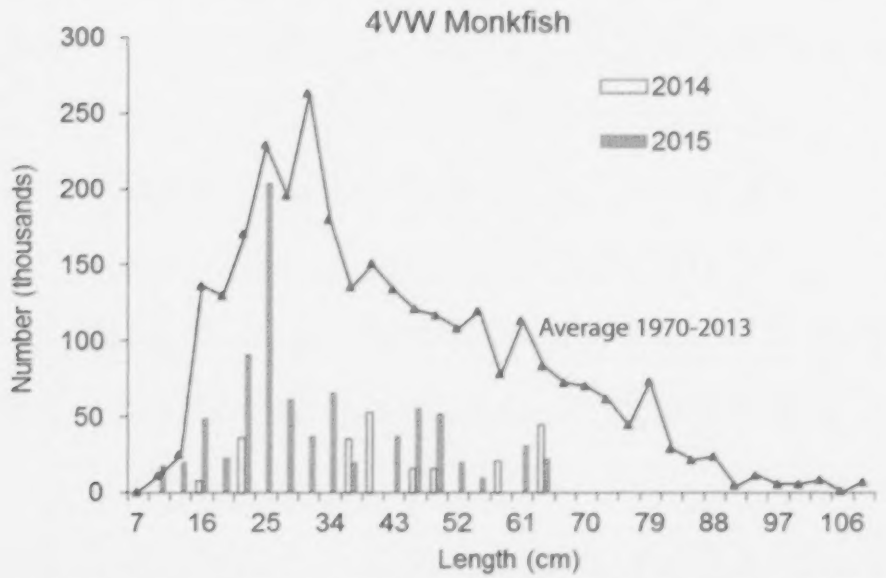

Figure 15e. Length frequency indices for Monkfish in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Longhorn Sculpin

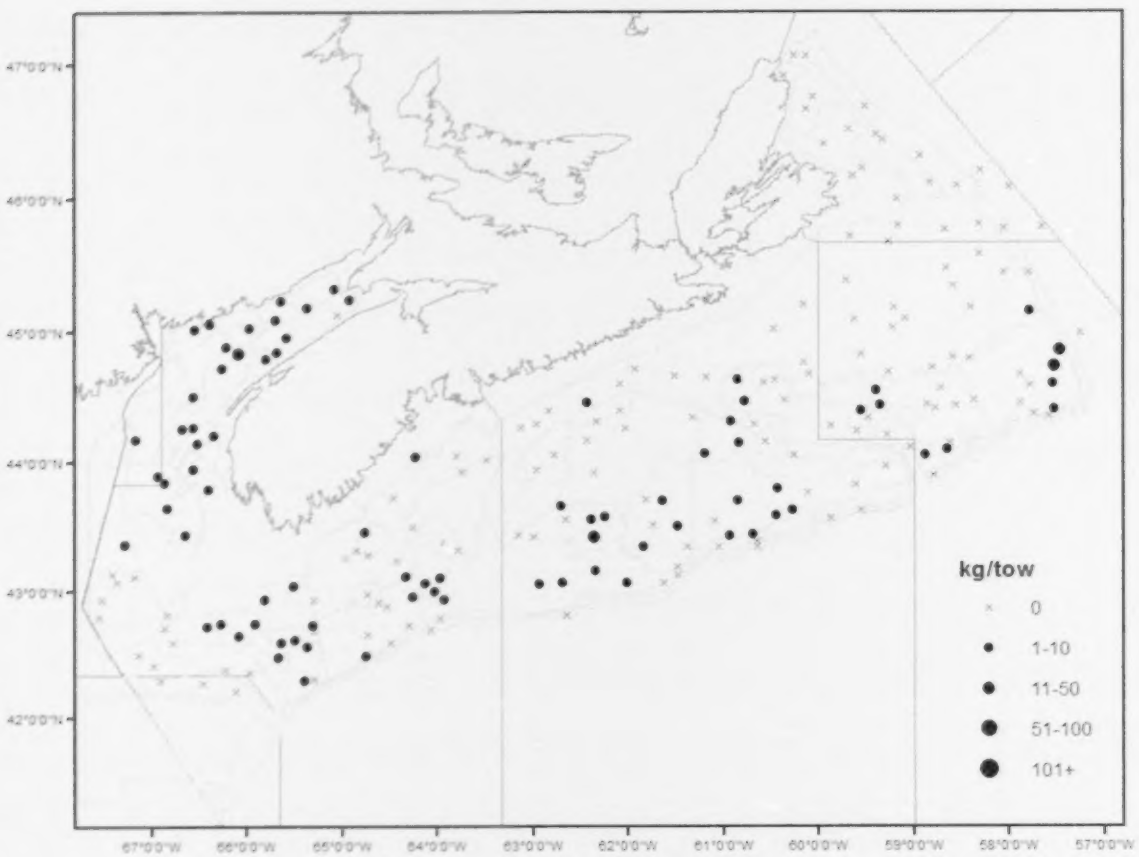

Figure 16a. Distribution of Longhorn Sculpin catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

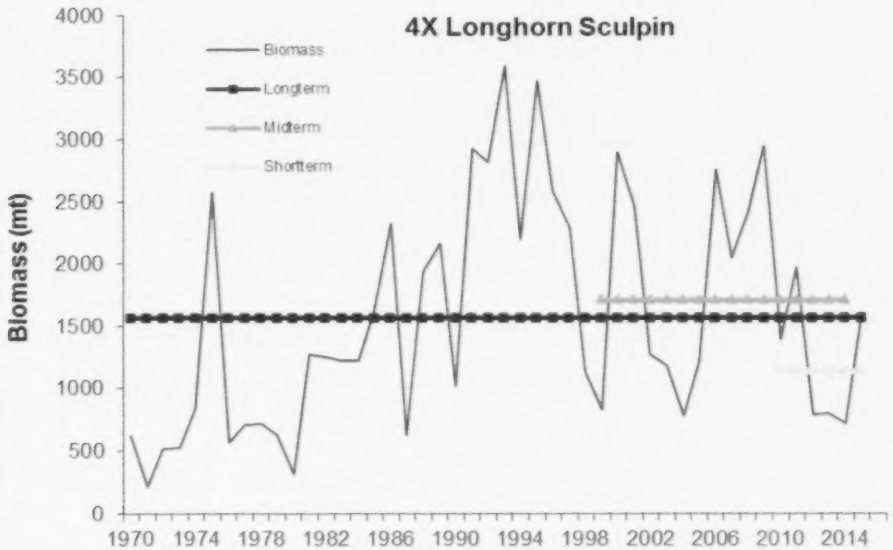

Figure 16b. Biomass index for Longhorn Sculpin in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

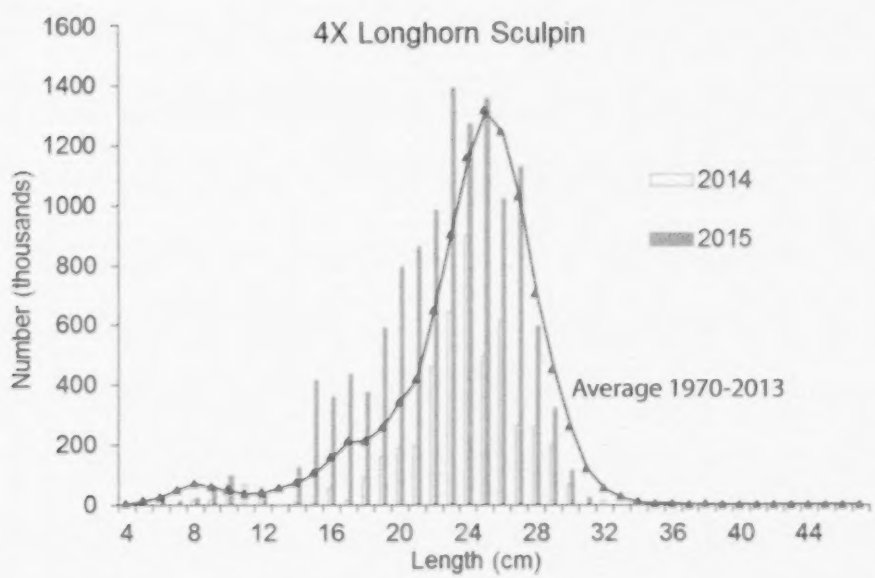

Figure 16c. Length frequency indices for Longhorn Sculpin in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

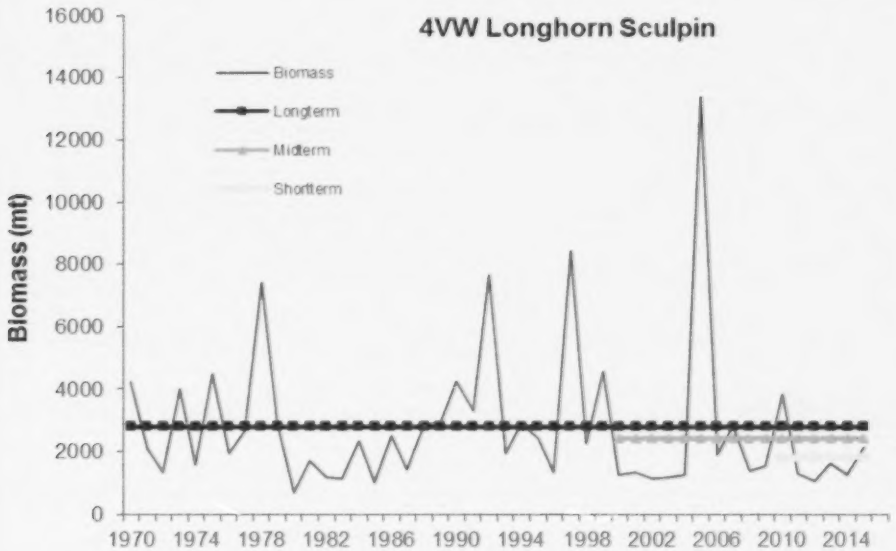

Figure 16d. Biomass index for Longhorn Sculpin in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

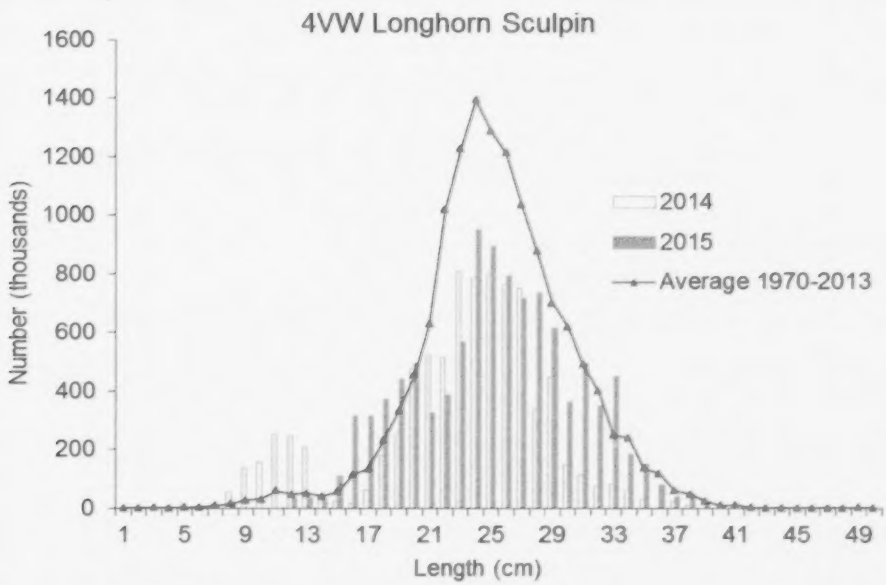

Figure 16e. Length frequency indices for Longhorn Sculpin in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Barndoor Skate

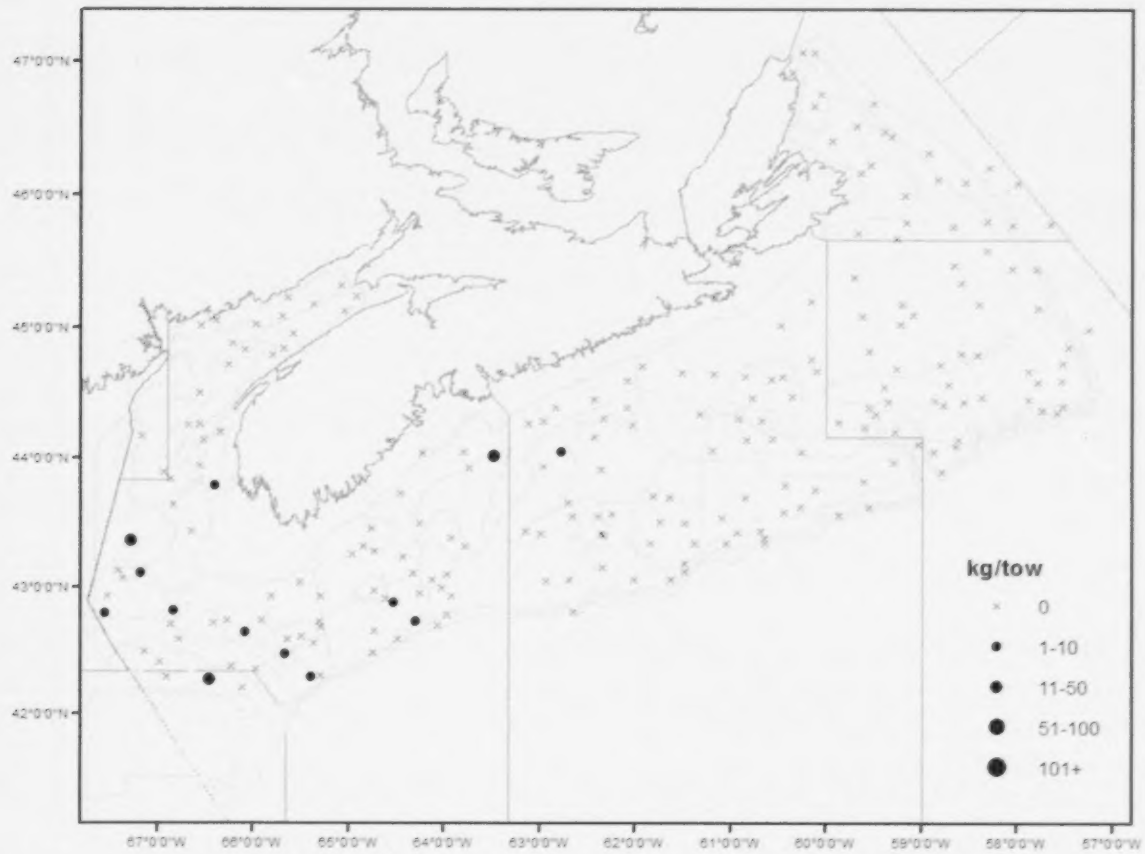

Figure 17a. Distribution of Barndoor Skate catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

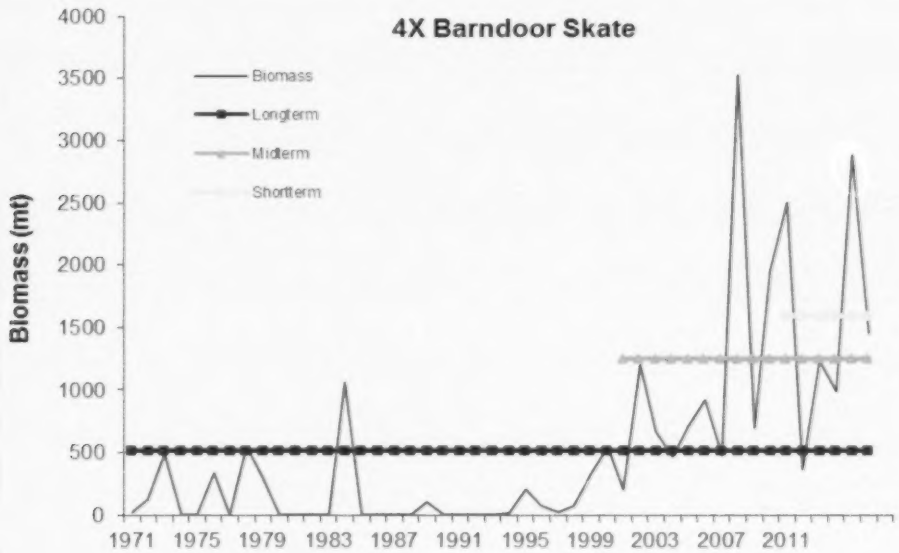

Figure 17b. Biomass index for Barndoor Skate in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

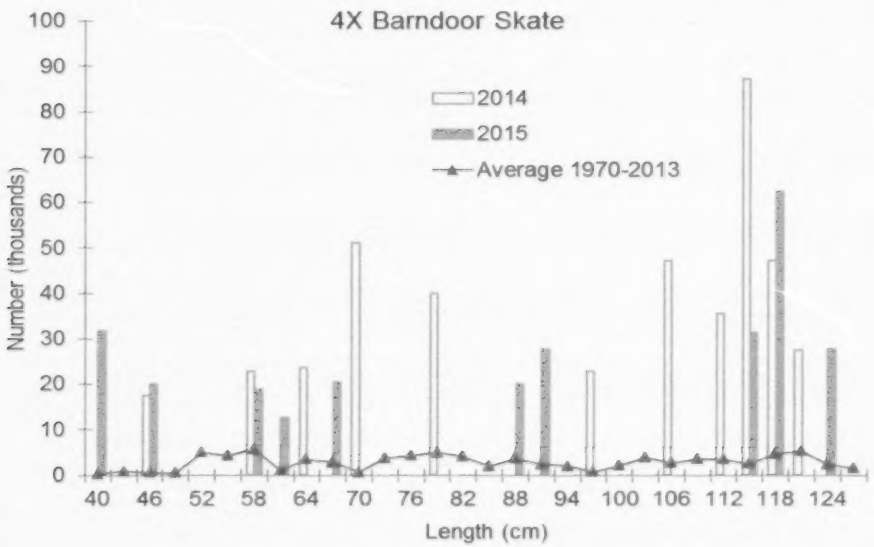

Figure 17c. Length frequency indices for Barndoor Skate in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

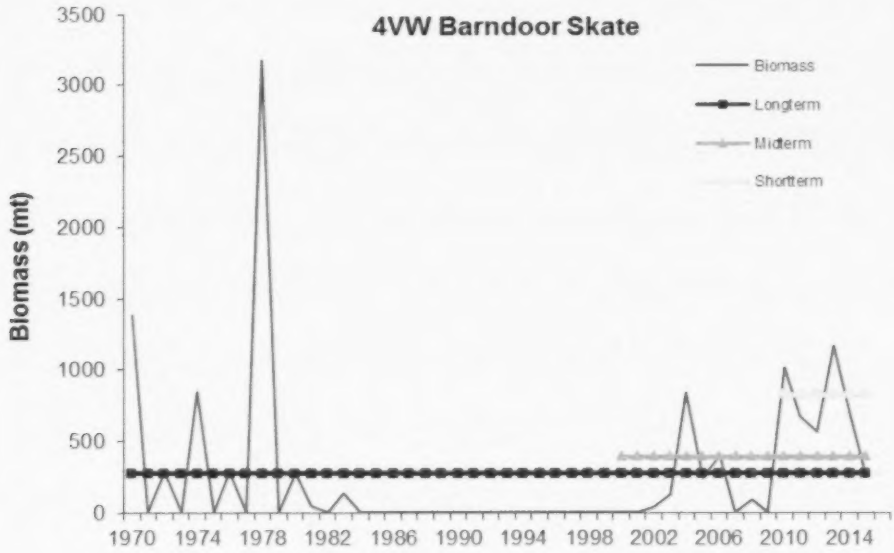

Figure 17d. Biomass index for Barndoor Skate in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

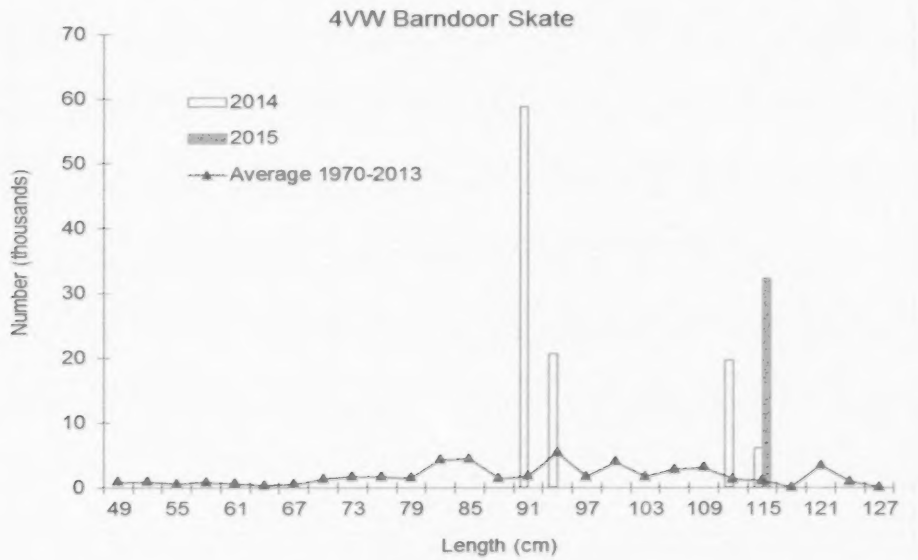

Figure 17e. Length frequency indices for Barndoor Skate in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Thorny Skate

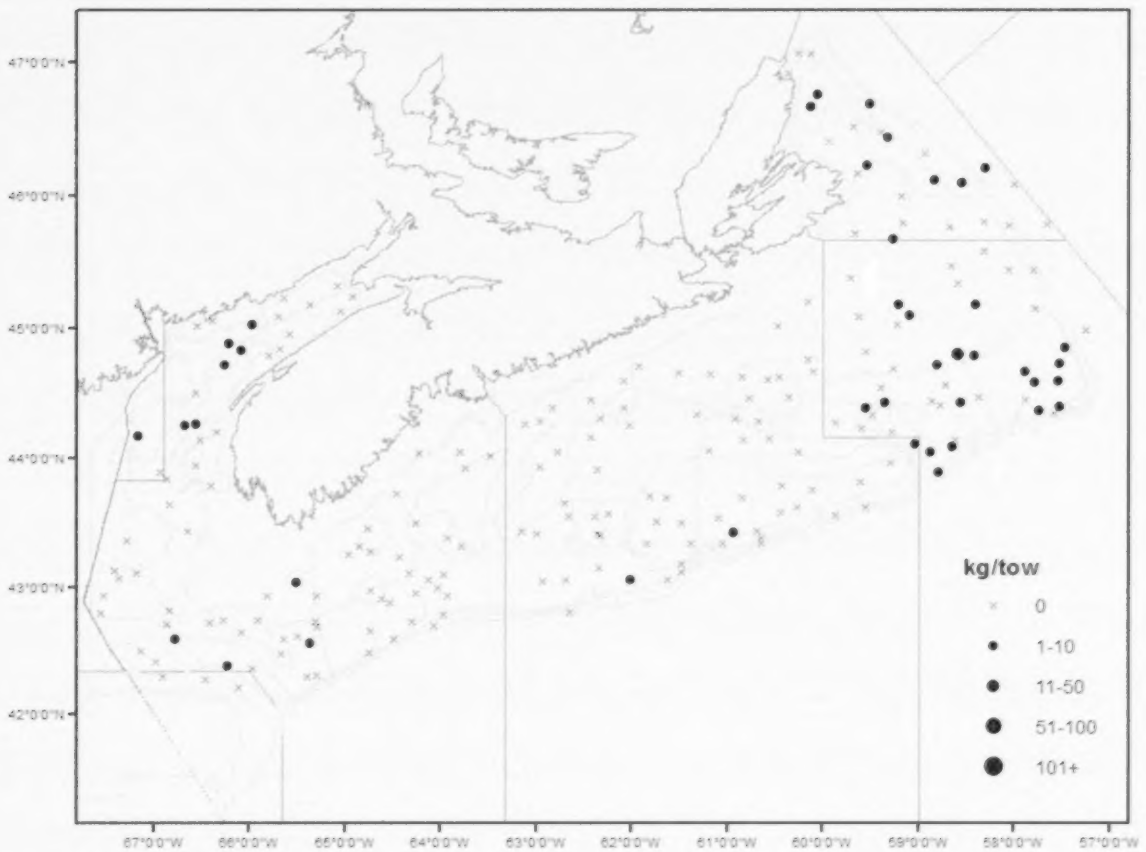

Figure 18a. Distribution of Thorny Skate catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

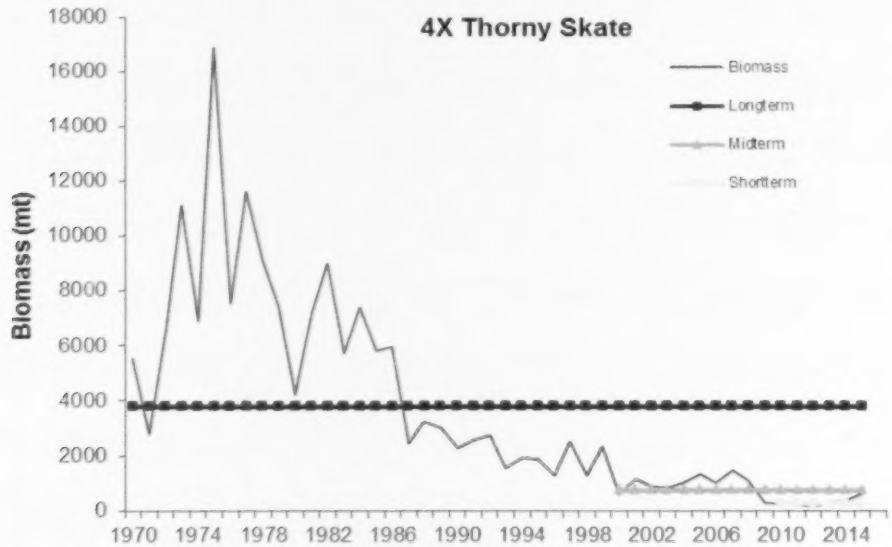

Figure 18b. Biomass index for Thorny Skate in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

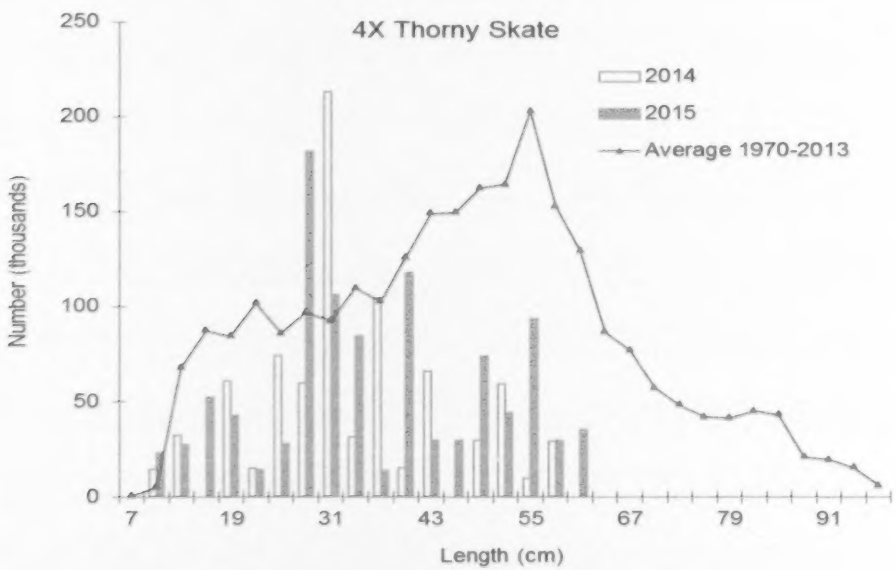

Figure 18c. Length frequency indices for Thorny Skate in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

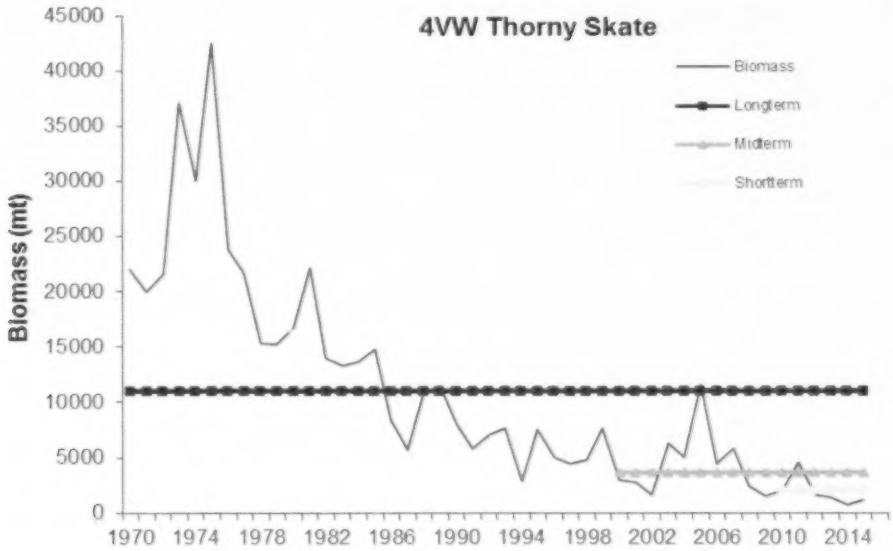

Figure 18d. Biomass index for Thorny Skate in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

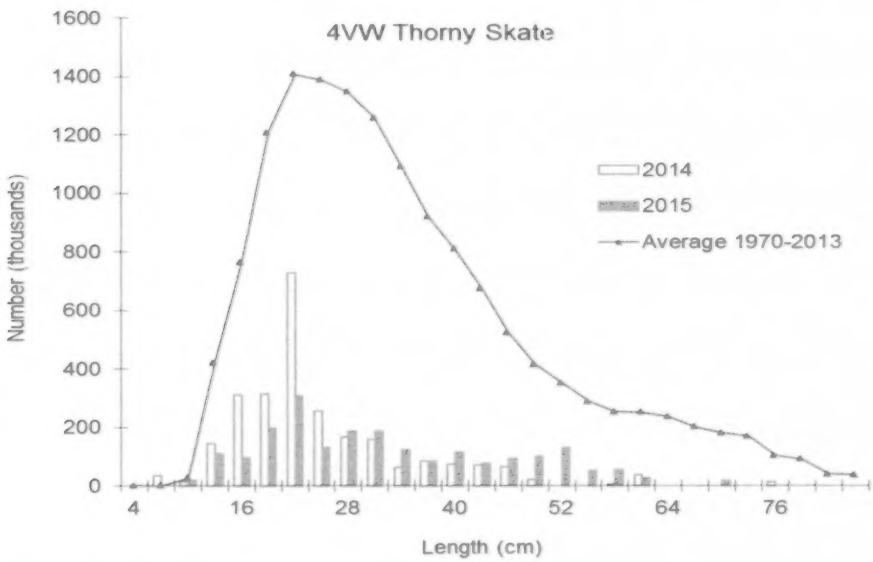

Figure 18e. Length frequency indices for Thorny Skate in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Winter Skate and **Little Skate** cannot be reliably distinguished at lengths less than about 40cm. Given that the majority of the Winter and Little skates captured in the surveys are in this length range, the biomass trends are influenced by the contribution of fish for which identification is uncertain (for more information see McEachran and Musick 1973).

Winter Skate

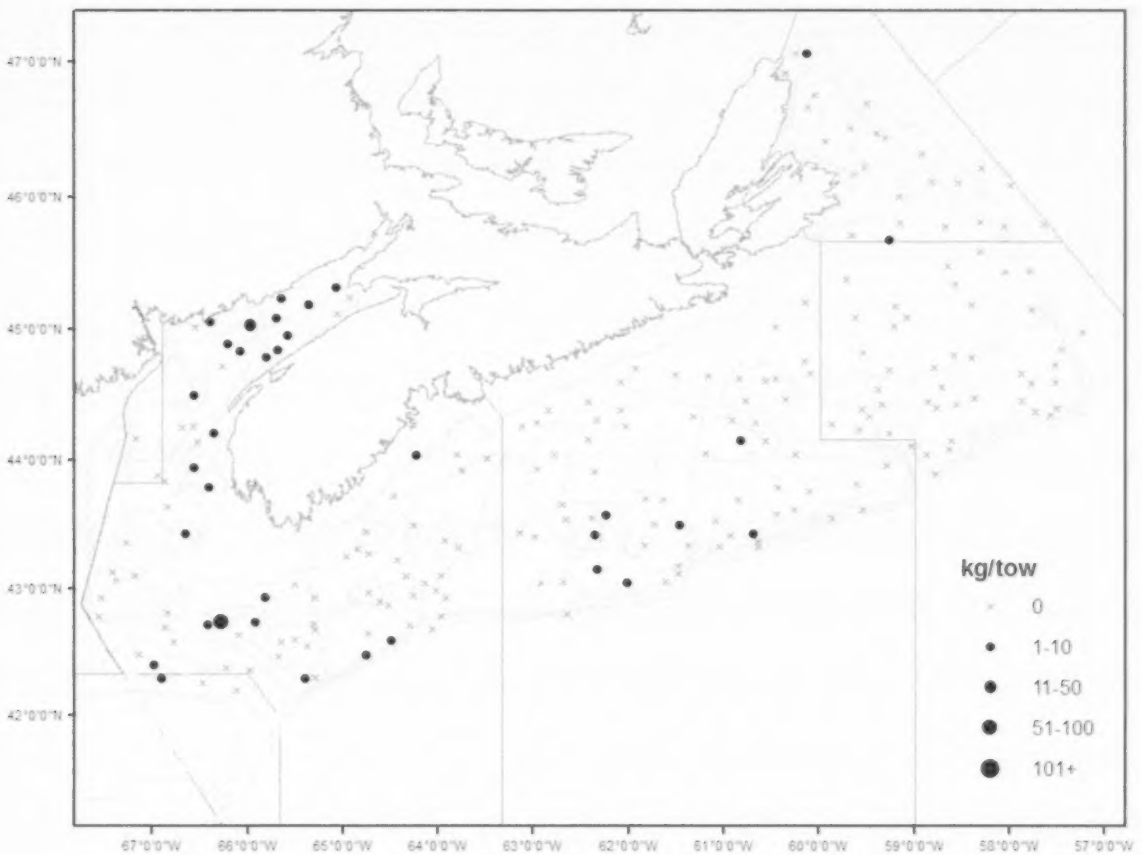

Figure 19a. Distribution of Winter Skate catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

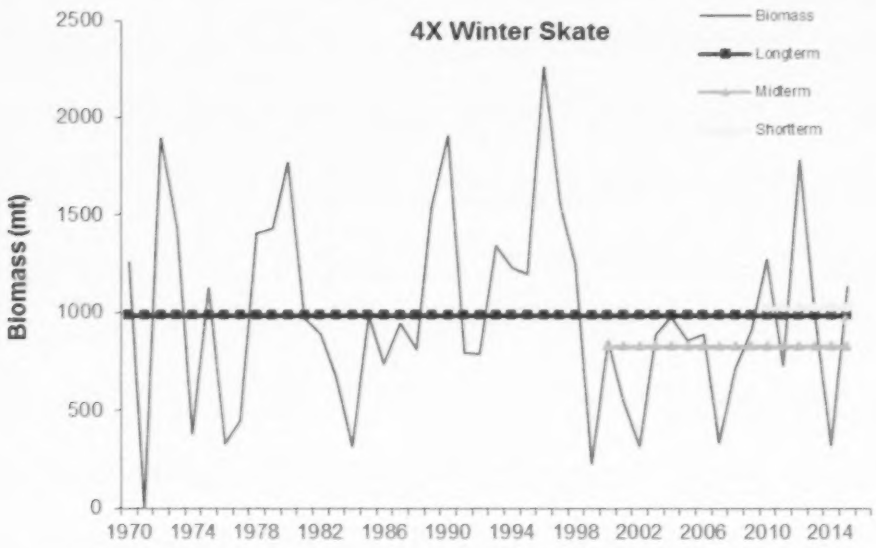

Figure 19b. Biomass index for Winter Skate in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

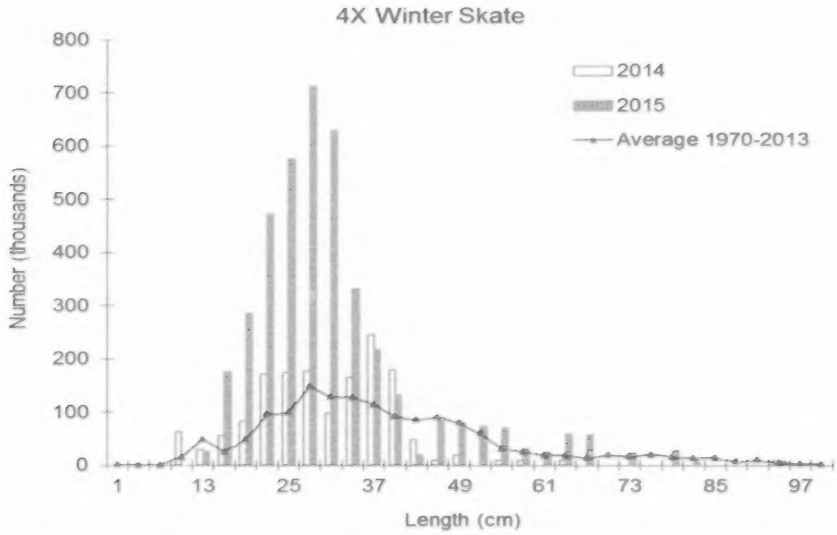

Figure 19c. Length frequency indices for Winter Skate in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013. Winter Skate and Little Skate cannot be reliably distinguished at lengths less than about 40cm. Standard practise at sea has been to include small undifferentiated skates as Winter Skate.

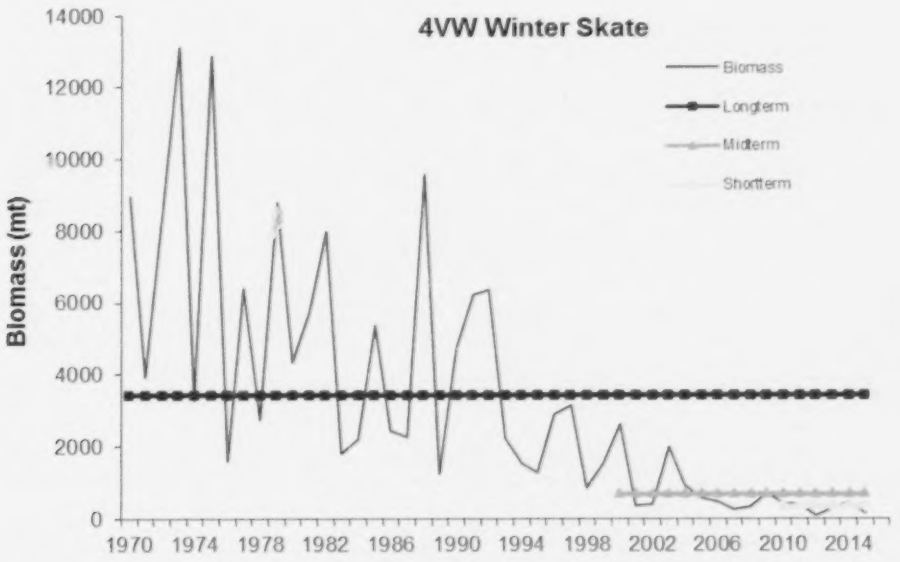

Figure 19d. Biomass index for Winter Skate in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

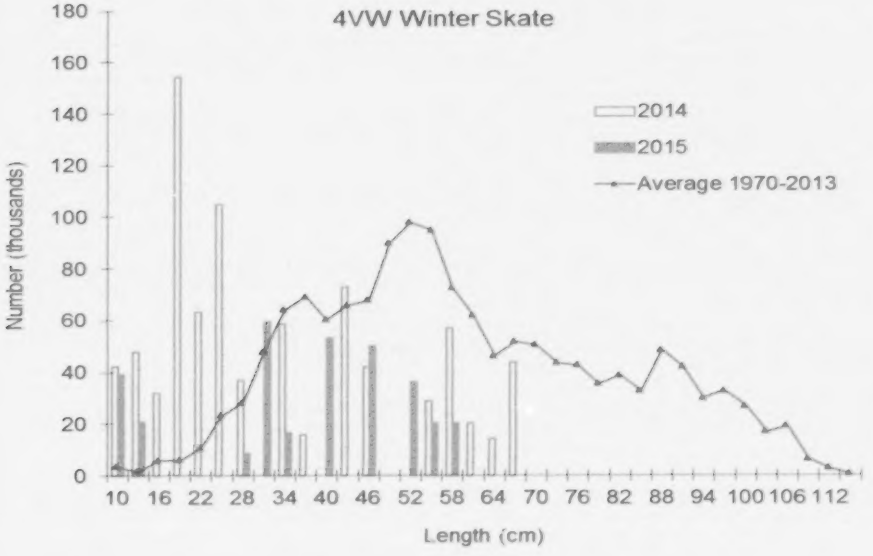

Figure 19e. Length frequency indices for Winter Skate in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Little Skate

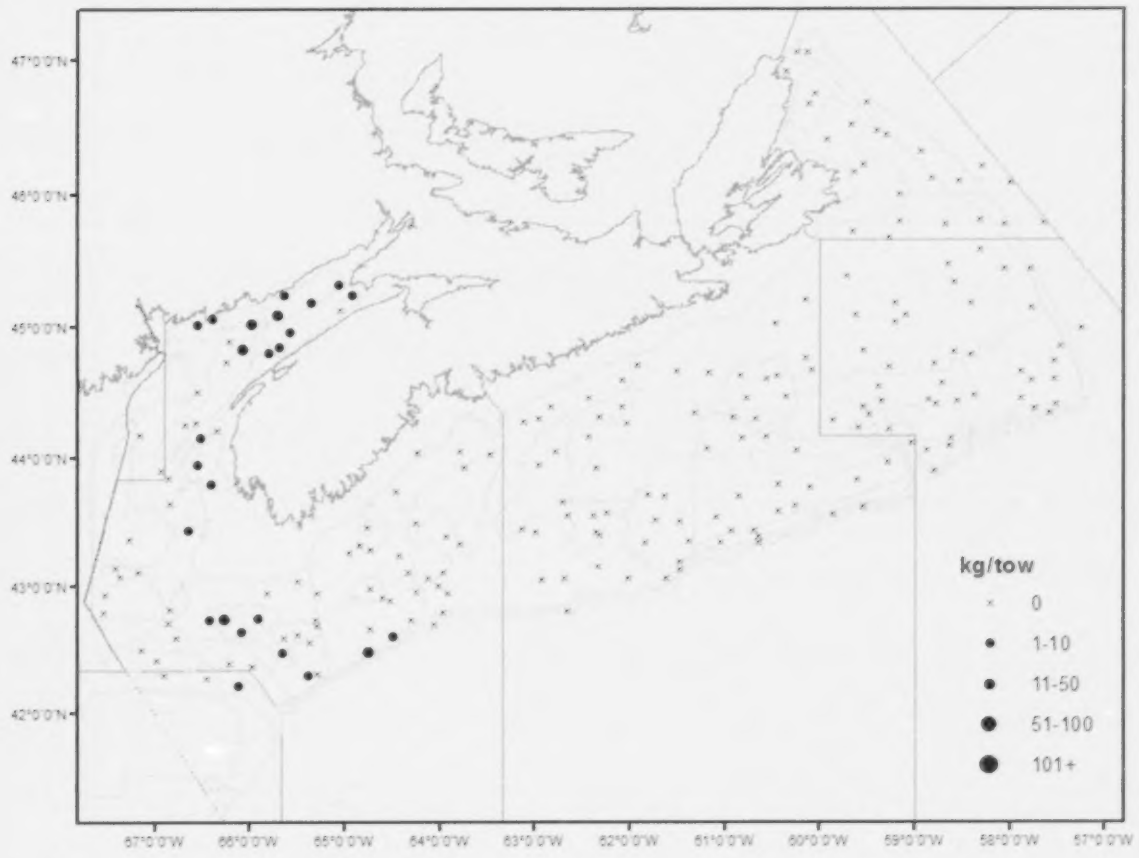

Figure 20a. Distribution of Little Skate catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

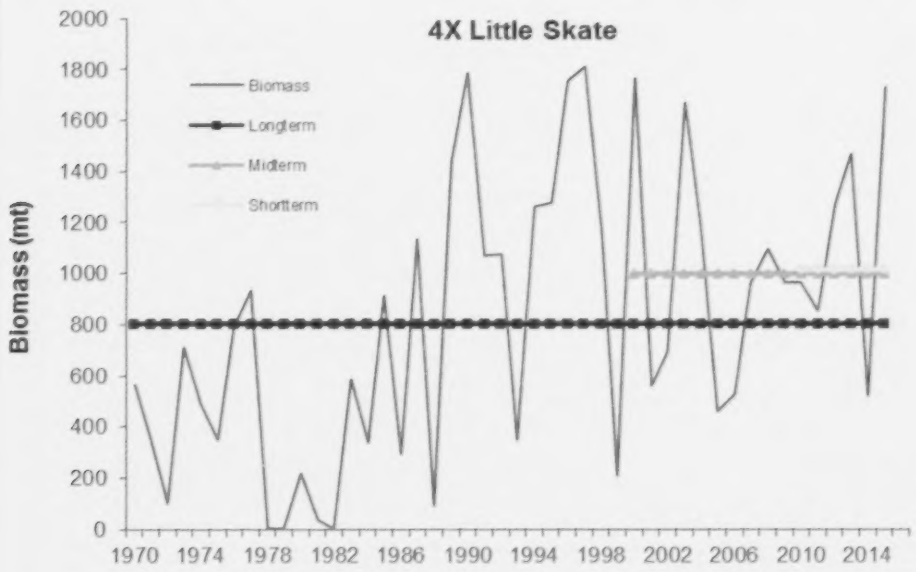

Figure 20b. Biomass index for Little Skate in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

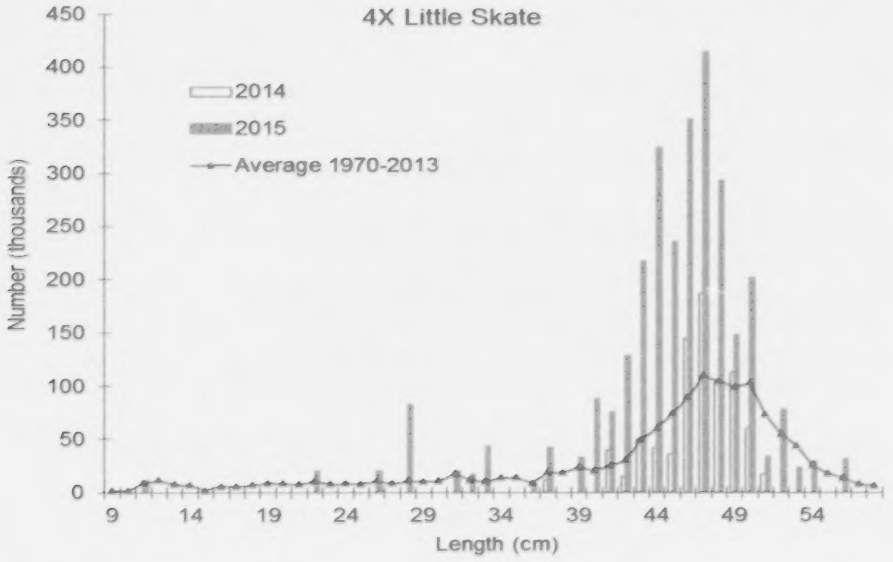

Figure 20c. Length frequency indices for Little Skate in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

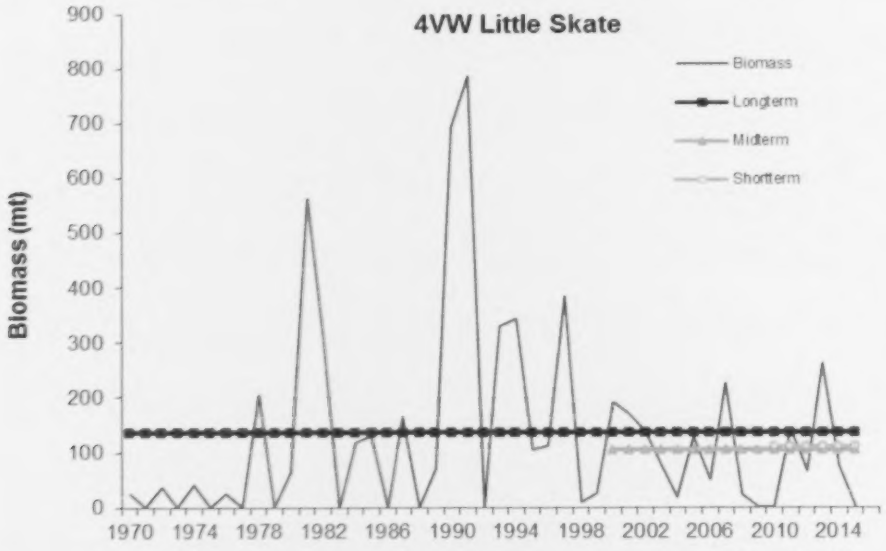

Figure 20d. Biomass index for Little Skate in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

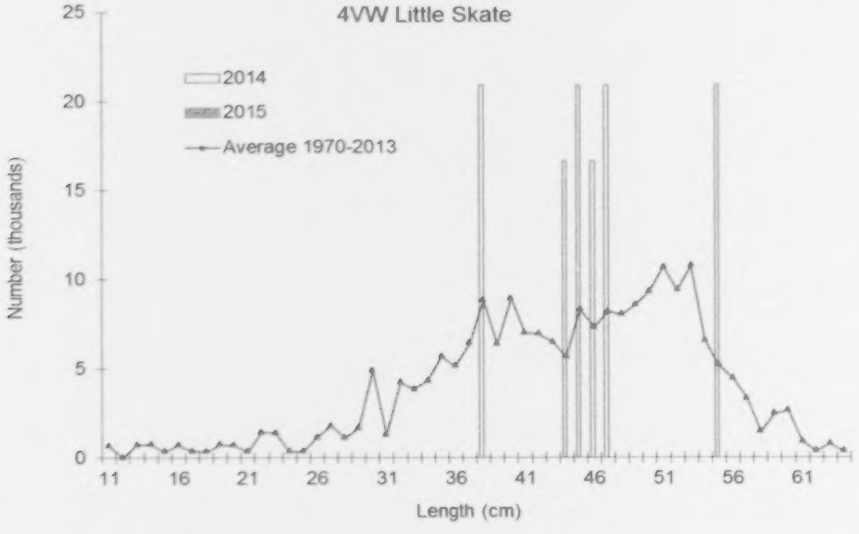

Figure 20e. Length frequency indices for Little Skate in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Smooth Skate

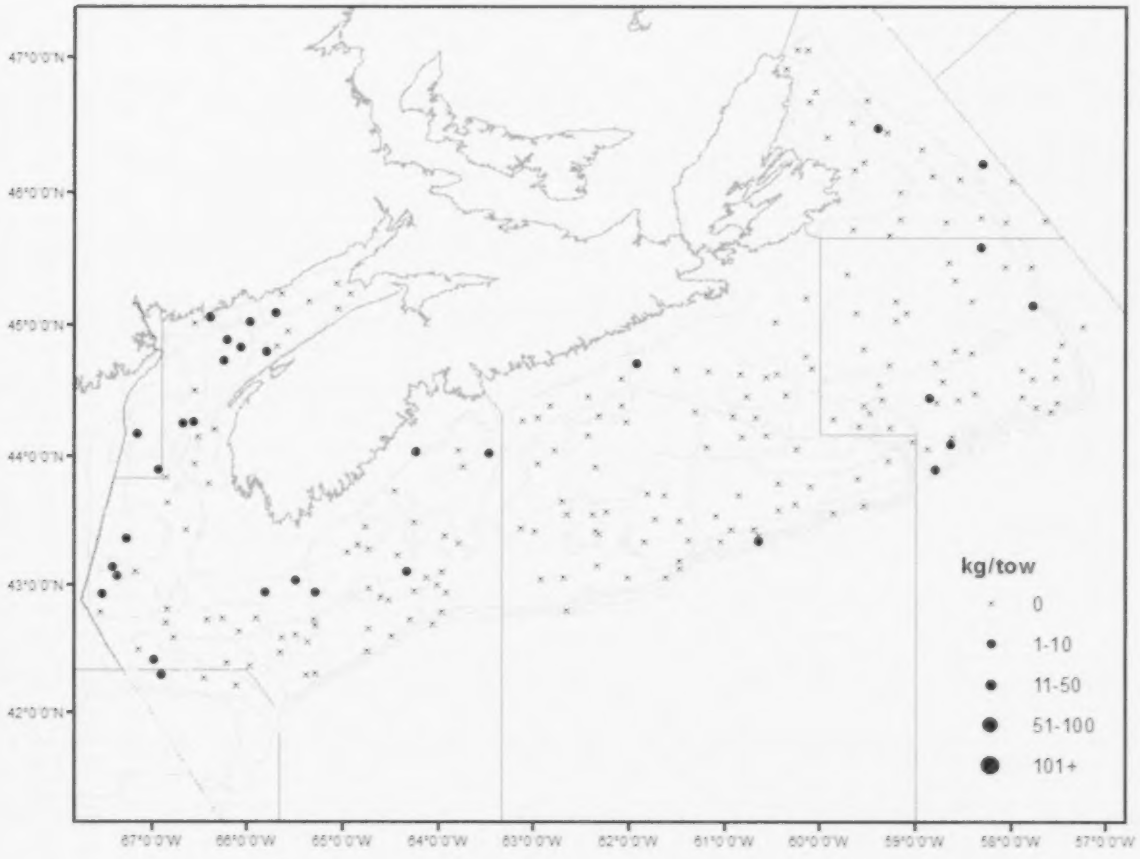

Figure 21a. Distribution of Smooth Skate catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

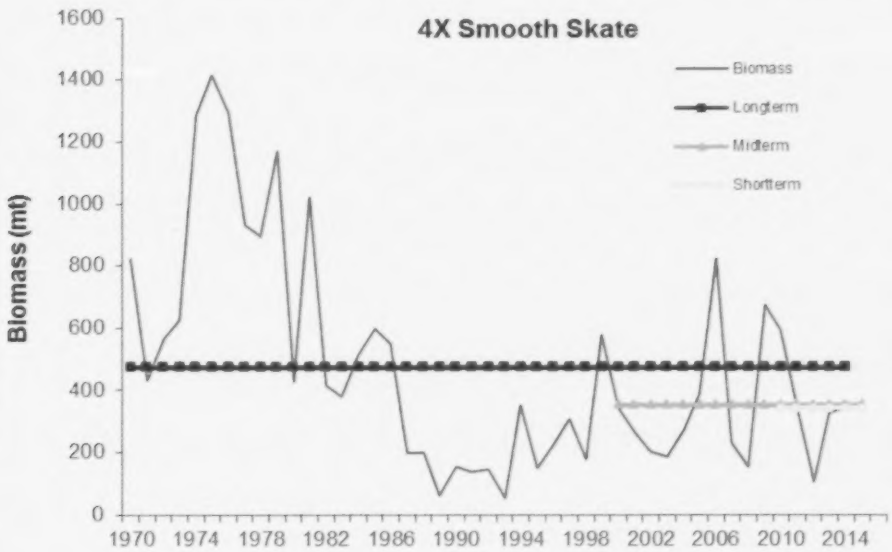

Figure 21b. Biomass index for Smooth Skate in 4X from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

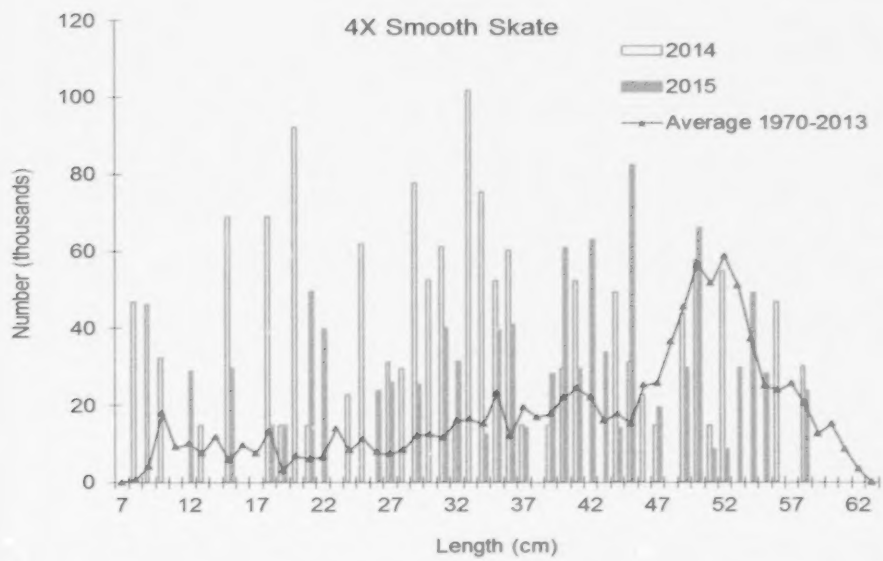

Figure 21c. Length frequency indices for Smooth Skate in 4X from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

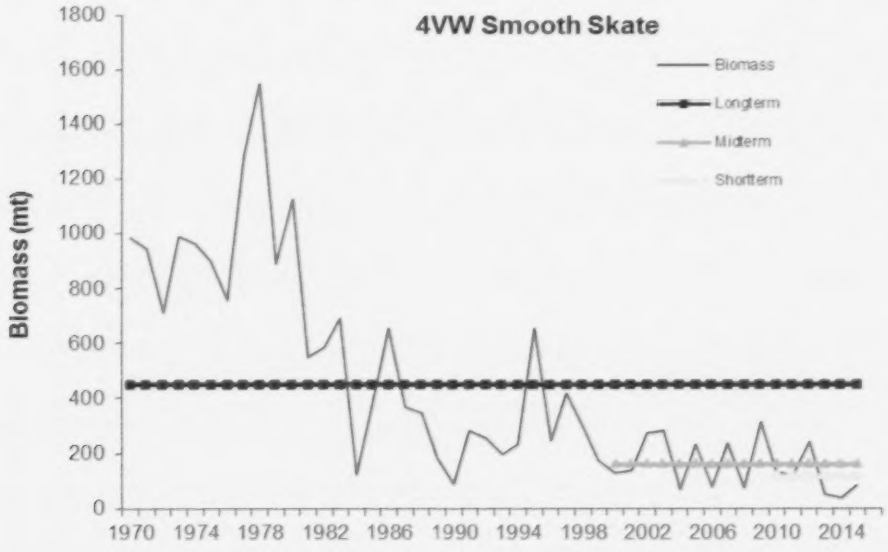

Figure 21d. Biomass index for Smooth Skate in 4VW from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

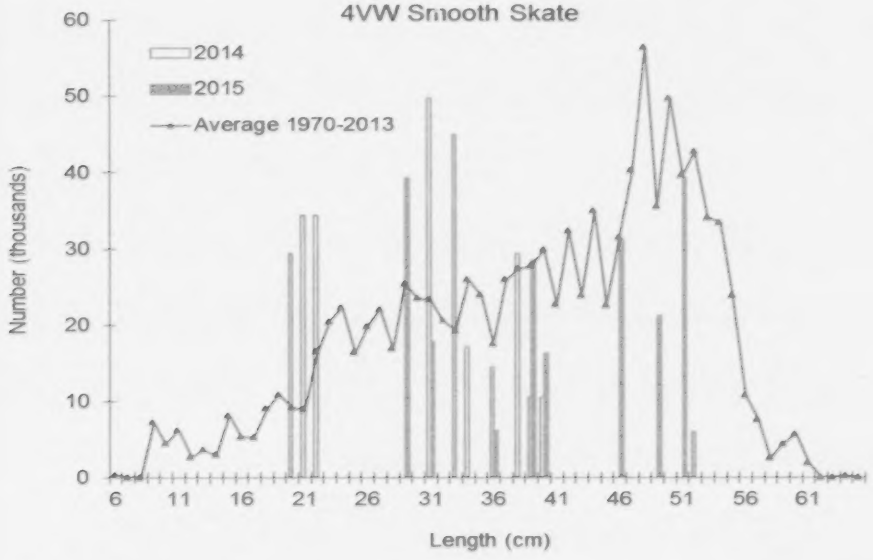

Figure 21e. Length frequency indices for Smooth Skate in 4VW from the Summer Research Vessel Survey. The solid red bars represent the number in thousands at length from the 2015 survey. The open green bars represent the number in thousands at length from the 2014 survey. The solid blue line with triangles represents the average number in thousands at length for the time period 1970-2013.

Spiny Dogfish

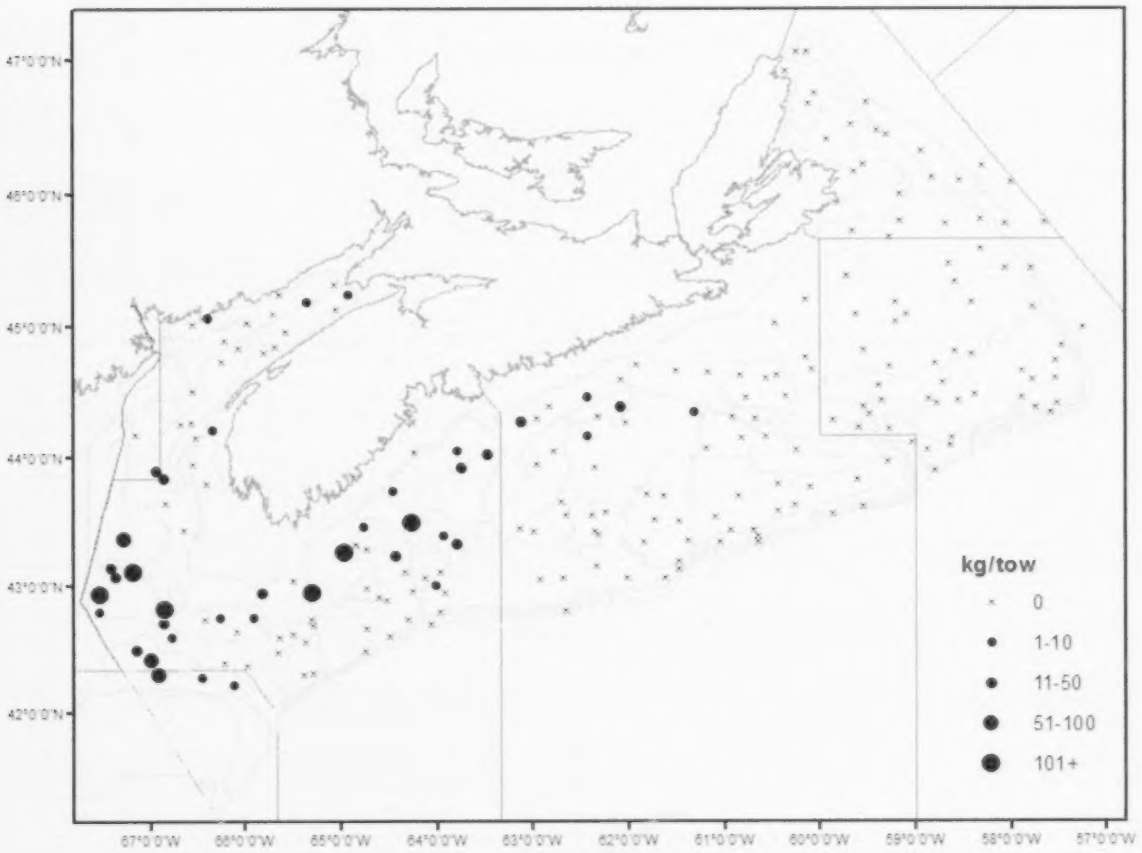

Figure 22a. Distribution of Spiny Dogfish catches during the 2015 Summer Research Vessel Survey. Zero catch is represented by the x symbol. Black circles represent catches. The circle area is proportional to the catch size.

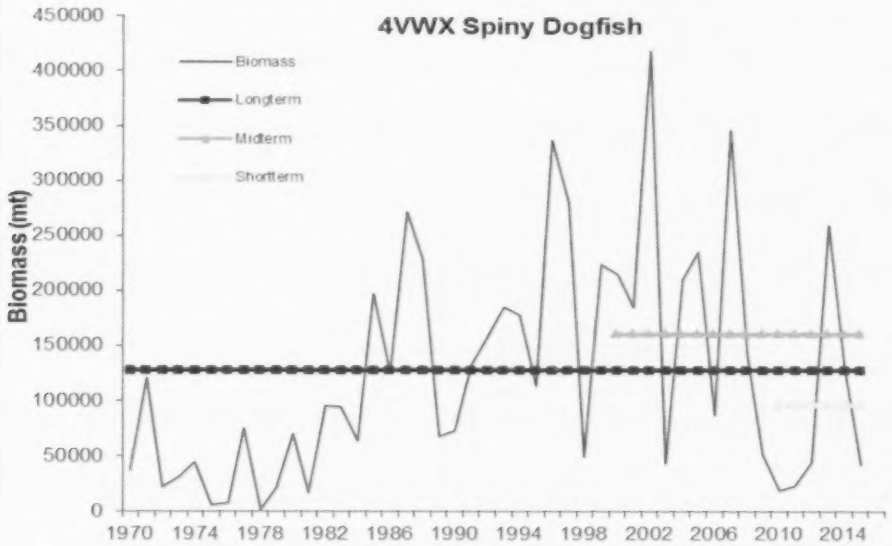

Figure 22b. Biomass index for Spiny Dogfish in 4VWX from the Summer Research Vessel Survey represented by the black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2014). The pink line with the solid triangles represents the medium-term 15 year average (2000-2014). The light blue line with the solid circles represents the short-term 5 year average (2010-2014).

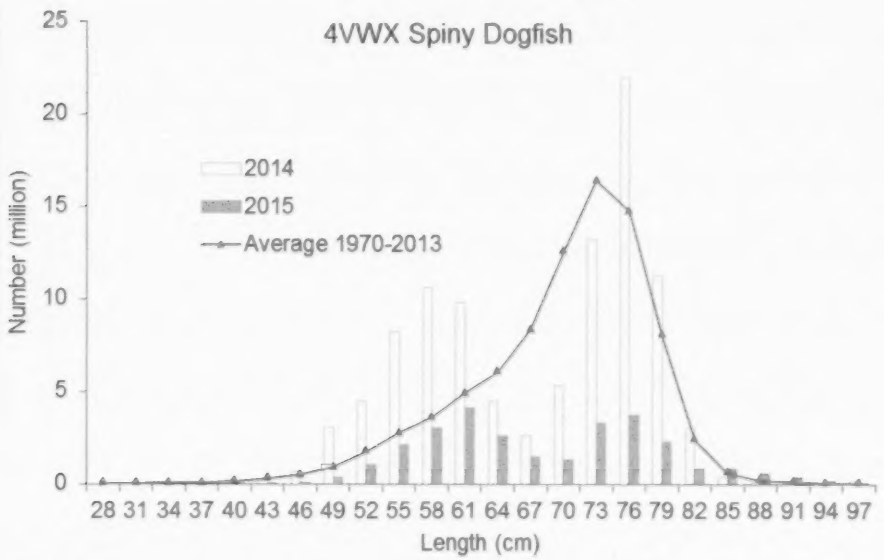

Figure 22c. Length frequency indices for Spiny Dogfish in 4VWX from the Summer Research Vessel Survey. The solid red bars represent the number in millions at length from the 2015 survey. The open green bars represent the number in millions at length from the 2014 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2013.

Conclusions

Biomass indices are compared with the averages over 3 time periods; short-term being most recent 5 year average, mid-term being most recent 15 year average and long-term being since the beginning of the survey series, or the period deemed appropriate for that particular species. A comparison of length frequency indices for 2014 and 2015 with the long-term average from the beginning of the survey series, or the period deemed appropriate for that particular species, to 2013 is also presented.

Contributors

Donald Clark (Lead)	DFO Science, Maritimes
Jamie Emberley	DFO Science, Maritimes
Jennifer Ford	DFO Fisheries and Aquaculture Management, Maritimes
Lottie Bennett	DFO Science Maritimes
Adam Cook	DFO Science, Maritimes
Jeremy Broome	DFO Science, Maritimes

Approved by

Alain Vézina
Regional Director of Science
DFO Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-426-3490
Date: January 11, 2016

Sources of Information

Clark, D.S., and J. Emberley. 2011. Update of the 2010 Summer Scotian Shelf and Bay of Fundy Research Vessel Survey. Can. Data Rep. Fish. Aquat. Sci. 1238

McEachran, J.D., and J.A. Musick. 1973. Characters for Distinguishing Between Immature Specimens of the Sibling Species, *Raja erinacea* and *Raja ocellata* (Pisces: Rajidae). Copeia 1973: 238-250.

This Report is Available from the

Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive, PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2

Telephone: 902-426-7070
E-Mail: XMARMRAR@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-3769
© Her Majesty the Queen in Right of Canada, 2016

Correct Citation for this Publication:

DFO. 2016. 2015 Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy. DFO Can. Sci. Advis. Sec. Sci. Resp. 2016/011.

Aussi disponible en français :

MPO. 2016. Tendances dans les relevés par navire scientifique sur le plateau néo-écossais et dans la baie de Fundy dans la région des Maritimes en 2015. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2016/011.